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Instruments for Hardness Tests

By C. F. CLEWELL

This article lays stress upon the importance of hardness tests. Reference is made to the early form of Brinell hardness determination and also to two recent modifications. The scleroscope is described and several examples of its use are given. Notes are included on the use of this instrument as a check on the pyrometer in the heat treatment of steel. The methods suggested for holding the various materials when under test are shown by accompanying diagrams.

THE uses for instruments to measure the hardness of metals make a brief study of the methods for such measurements of considerable interest. Some of the measurements for which such instruments are desirable include, in addition to the measure of the hardness of metals, the determination of the degree of annealing, the test of material to see if it comes up to specifications and the detection of separation in an alloy. In experiments with new alloys such tests may be used as a guide in the change of hardness due to the addition or subtraction of any one element.

Other uses for hardness-testing instruments are measuring the hardness of carbon and similar substances, determining the nature of the grain in hardened steel, and measuring the so-called "red hardness" and the capacity of high-speed steel for metal cutting. By this means it is also possible to test the hardness of such special material as the steels for automobile parts and to ascertain the carbon content of steel.

FIG. 1. A SIDE VIEW OF THE SCLEROSCOPE

Present types of machines for the Brinell hardness test are based on forcing a ball of standard diameter into the steel to be tested by a load of standard amount applied hydraulically. Previously hardness tests were made largely by indenting the surface of the metal under test by a conical point under a pressure of known degree, in which the depth the given point penetrated the metal was taken as a quantitative measure of hardness.

The modification of this earlier form of hardness test from a conical point to a steel ball was due to J. A. Brinell. Developments of this principle consisted in designing special presses and the accurate measurement of the dimensions of the depression caused by the steel ball as well as methods for calculating therefrom the factor of hardness. Both the earlier method of the conical point and the later use of the steel ball were limited in their application because of the inability to make a depression in metals that were as hard as the point or as the ball.

On the other hand the present types of Brinell machines are satisfactory under laboratory conditions and where hardness tests are required on a large scale, for example in the checking up of raw material. Where a high degree of accuracy is not essential simpler forms of the Brinell machine have been devised, as referred to in what follows.

About twelve years ago investigations were made in this field of measurement by A. F. Shore, who developed the scleroscope for hardness testing. Briefly stated, the principle of the scleroscope is based upon the rebound of a hard-steel hammer equipped with a formed diamond at its striking end. This small hammer is dropped on the surface of the metal to be tested, and after striking this surface the hammer rebounds to a height proportional to the hardness of the metal; this hardness is then read directly from the vertical scale along the side of which the hammer moves. When the hammer strikes the surface under test a dent, depending on the hardness of the metal, is made.

Fig. 1 shows a side view of a self-contained scleroscope, and Fig. 2 a front view of the same instrument. In the latter case the scale is clearly visible. For small or thin flat pieces the handle (shown to the right in Fig. 1 and in the rear in Fig. 2) is used to clamp the material to the anvil.

In the use of the swinging arm, as indicated to the right in Fig. 2, the scleroscope is mounted at the end of the arm and may then be used for testing on the surface of a large piece of metal or for measurements on pieces held in a bench vise and which could not conveniently be tested on a flat surface. The adaptation of this swinging arm to bench work is illustrated in Figs. 3, 4 and 5. In Fig. 5 tests are being made with the scleroscope for small parts without the stand and swinging arm.

The following notes apply to the practical handling of the scleroscope. In the operation of the small hammer the action is pneumatic. Thus, in pressing the rubber

bulb (Fig. 3) and then releasing it, the hammer is drawn up by suction to the topmost position and is there held mechanically. Pressing the bulb again releases the hammer and permits it to drop to the surface of the metal under test.

The actual method of supporting the instrument for

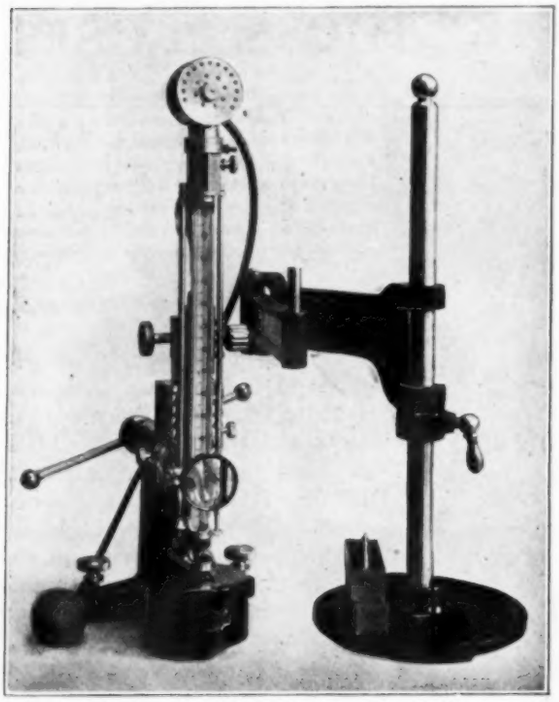


FIG. 2. SCLEROSCOPE WITH SWINGING ARM

thin, flat or other small pieces of work is explained in the foregoing, but in addition it is also possible to operate the scleroscope free hand and thus accommodate any size of work. To insure that the small hammer will drop freely it is necessary to have the instrument in a vertical position before the hammer is released. A bob rod (to the right of the scale in Fig. 2) is ordinarily used for leveling, the tripod screws being employed when the instrument is used in its own clamping stand as in Fig. 1. When used with the swinging arm or free handed a plumb bob is used for leveling.

A level surface should always be available in making the hardness test, especially so when the degree of hardness is high. This surface need not be more than a small spot at the point where the diamond tip of the hammer strikes. For very hard metal the tested surface should also be smooth, although it should not be an actual polish.

In observing the height of the rebound of the hammer after it strikes the metal surface some little dexterity is required at first to catch the exact height of the hammer at the instant before it again begins to fall after the rebound. It is suggested that when hardened steel is being tested the observer should look for this height at or near 100. In like manner, when medium hard steel is tested, the rebound will be near 50 on the scale. For soft metals it will probably be near 10 to 15. Good illumination is also a factor in accurate readings of this instrument, and the glistening effect on the top of the hammer when the light strikes it from the proper direction acts as a guide.

In the use of this device the hammer should never be allowed to strike more than once at the same point, and in fact not too near the first point. All pieces under test must be clamped solidly. Most of the testing should be done in a bench vise with the scleroscope used in the swinging arm. Where many pieces of the same kind are to be tested some form of holding jig should be made. In some castings with large crystals, where a variation in the readings is noted at regular intervals across the sample, the actual hardness is to be taken as the average of all the readings.

Several suggestions for jigs to hold parts under test are given in Fig. 4. The diagram to the left illustrates the use of plates in a bench vise for holding balls during the test. The plate to the right is countersunk, while the other is flat. In testing the surface of tubing a scheme like that shown to the right in Fig. 4 may be used. Here two plates are used in the vise for jamming down the tube on the plug placed within the tube. The spot at which the test is to be made is shown by an arrow in each case.

The pressure of the hammer used in the scleroscope, due to the very small area of the point of contact, may be as much as 500,000 lb. per square inch. The height of the hammer fall is 10 in. and the diameter of the hammer somewhat less than $\frac{1}{4}$ in., with a length of $\frac{3}{4}$ in. It weighs about $\frac{1}{13}$ oz., and the diamond striking tip is slightly spherical and blunt with a diameter of about 0.02 in. A value of 100 is chosen as the arbitrary numerical value of the hardness of quenched carbon steel, which makes the hardness of lead on the order of 2.

In metal working it is found that soft lead with a hardness of 2 can barely be cut by a lead alloy of a hardness of 4, and the same relation exists between metals with hardness factors of 4 and 8, 8 and 16, and so on, until it is found that to cut steel of a hardness of 50 the cutting tool must have a hardness of close to 100; that is, twice as great. These figures relate moreover to cutting slightly without an instantaneous loss of the cutting edge. To preserve the edge of the cutting tool over a short interval a ratio of $2\frac{1}{2}$ to 1 is required, and in a commercial cutting tool the minimum ratio of hardness must be 3 to 1. Thus, if a cutting tool has a hardness of 100 the material which it can be used to cut cannot have a hardness of more than say 34 unless overheating of the edge of the tool is prevented either by using a lower feed, speed or other means.

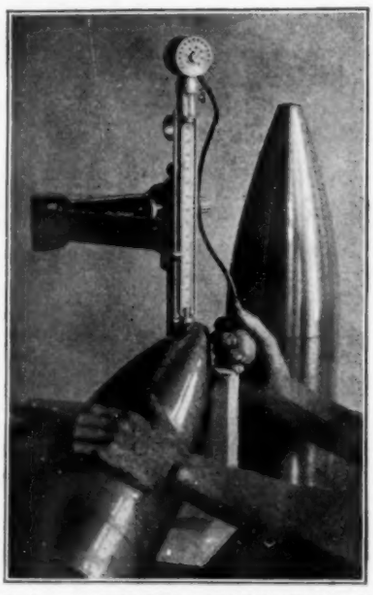


FIG. 3. TESTING HARDNESS OF SHELLS

This subject is touched upon here as one of the practical aspects of shop work in its relation to the question

of hardness and to point to the usefulness of the instrument under discussion.

Tests were made on automobile parts that had undergone heavy service, and in the disassembling of the machines that were used as the basis of the tests a study was also made of the following points:

The matter of battering and shearing of the parts because of their being too soft at the core when case-hardened, or when hardened without cementation, or when not heat treated at all. Also for wear due to a

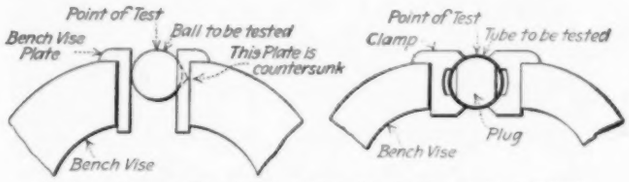
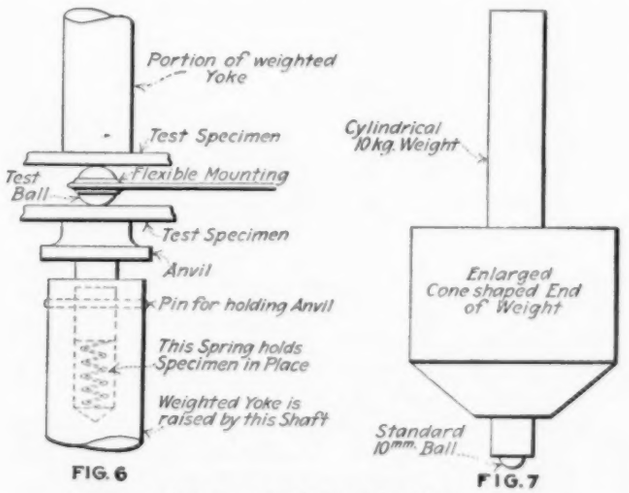


FIG. 4. VISE CLAMPS FOR HOLDING TEST PIECES

lack of hardness; for chipping of corners due to an excess of hardness; for fatigue because of an elastic limit and a hardness which was too low, and for crystallization and fractures due to insufficient toughness where the hardness was sufficiently high. It was found that the hardness standards finally adopted did not apply to all kinds of steel and in particular to plain carbon steel, in which the toughness rapidly decreases as the hardness is increased.

A few of the numerical hardness readings obtained from these tests will show the tendency toward standardization. Thus for automobile frames of chrome-nickel steel the readings of hardness range from 40 to 45; for plain carbon steel, from 35 to 40; for axles of chrome-nickel steel (0.35 carbon), 40 to 45; for springs of very elastic and superior quality made of vanadium steel, from 65 to 80, and of plain carbon steel, 60 to 75. Other readings were found for crankshafts, transmission



FIGS. 6 AND 7. BRINELL HARDNESS TESTS
Fig. 6—Applying Brinell hardness test to two specimens at once.
Fig. 7—Special device for obtaining Brinell hardness

shafts, transmission gears, starting crankshafts, pump shafts, piston pins and for a variety of other automobile parts.

One use of the scleroscope is as a check on the pyrometer in the heat treatment of steel. If not properly calibrated at sufficiently short intervals a pyrometer might vary with length of service enough to impair the value of high-grade steel. In such cases the scleroscope may be employed to test the hardness of the steel and check the reading of the pyrometer.

Another application is in the tests of armor plate, projectiles and gun metals. The resisting power of ar-

FIG. 5. USING THE SCLEROSCOPE WITHOUT THE STAND

mor plate is investigated after the use of the proper materials and suitable heat treatment on a basis of the hardness test. Similarly projectiles, where all the other conditions are adhered to, may be said to have a penetrating power that is proportional to their hardness, thus offering a channel for tests by this device.

Other applications include the study of the depth of hardening in steels, and the study of shop conditions in regard to the best conditions of cutting tools and the metals worked upon, with the idea of increasing the economy of production.

Modifications of the Brinell Test Machine

Several other modifications of the original Brinell test device may be mentioned, and are referred to in Figs. 6 and 7. The one illustrated in Fig. 6 was devised for use on cartridge brass. The principle on which the first revised form was based was simply a yoke weighted down to 500 kg., and carrying the test ball, an automobile jack being so arranged as to lift the yoke with the test piece between the jack and the test ball.

A description of the improved machine, which followed the first crude device, is essentially as follows: An iron stand that had been cast aside was employed. A vertical shaft operated by a threaded bevel gear was substituted for the jack, and the shaft so fitted to a bearing at the bottom as to move freely. A handwheel (not shown) produces a motion of 0.01 in. per revolution, and calls for approximately four turns to produce the necessary impression in the test piece. By the scheme clearly shown two specimens may be tested at one time. The spiral spring between the anvil and the vertical shaft was introduced to aid the test. By this means the two test pieces are held in place until the

load is applied and are prevented from falling when the load is released.

Another scheme was devised and reported by J. G. Ayers, Jr., where, instead of applying a dead load of standard amount, a standard impact was employed. A cylindrical weight of 10 kg. was employed with the lower end, having a cone shape, in which a standard 10-mm. ball was securely held, Fig. 7. The height from which this weight had to fall to produce an impression in the test specimen of 3-mm. diameter was found to be 70 mm. By the use of this impact as a standard various pieces of different hardnesses were tested, and the diameters of the test impressions were plotted (ordinates) against the numerical values of the standard Brinell machine (abscissas). The use of an impact rather than hydraulic pressure is quicker, hence this modified scheme has rapidity as one of its advantages in making tests on a large scale.

Muzzling the Punch Press

By C. H. Biron

With drawn sheet metal replacing cast or machined parts the punch press is used today more than ever, and as a result the accident curve of the average factory receives a good share of its stimulus from the mutilation of fingers and hands tending these machines. There are a number of devices designed to minimize the danger to operatives, many of which are not without merit, but there still remains room for improvement.

It is no easy matter to inaugurate the use of safety appliances on punch presses, and not least among the difficulties is the opposition of the operator whom the appliance is intended to safeguard. For example, recently a firm received a sample of a safety device the principles of which were promising and in actual use bore out its inventor's claims, but one unlooked-for drawback consigned it to the fate of its predecessors. The first tests were made in the presence of the officials, who were gratified with the results, and for the time being the operator shared the sentiment.

A Good Cause for Complaint

In the course of a day's work, however, a good cause for complaint became manifest. The device consisted primarily of a light wood bar that interposed crosswise and horizontally between the operator and the die, and which was pivoted at either end in such a manner that in placing work in the die the operator's forearms must displace the bar by raising it from its normal position, thus operating the nontrip feature. At its best working position the bar was close to the operator's line of vision, not enough to obstruct his view but still close enough to distract the natural focus of the eyes. The fault was obvious, and to the operator the element of uncertain accident was preferable to certain eyestrain.

The instance cited was on a production rate of 2000 an hour. On the heavier work of the toggle presses that are run at much slower rates and often expose the entire arm to amputation this discouraging characteristic is absent and safety devices become a necessity.

It is on the more rapid work that the appliances fall short and it is apparently little known that many accidents occur in a moment of confusion wherein the operator exposes his hand after the press has been tripped. There is no device, mechanical or otherwise, that meets this condition.

A common fault of devices that minimize danger is their tendency to minimize production as well. Speeds of 1500 to 2500 an hour are common with light forming or piercing operations, and the slightest unnecessary move consuming but a fraction of a second on each piece amounts to a considerable loss in the course of a day's work.

The Piecework System

Where piecework price systems prevail the employee complains that the device hinders his ability to "make out;" the shop foreman must attribute lower production at a higher cost to the use of safety appliances—in fact the antipathy becomes general, and safety devices are consigned to some obscure corner until another accident signals the loss of a valued employee and may develop into a costly lawsuit.

A great deal of danger can be eliminated at the start in the design of the tools themselves. Let the draftsman consider well the position of the operator's hand on the piece while placing it in the die (most accidents occur while the hand still grasps the piece) and endeavor in his design to leave clearance for the hand in case of an accidental tripping of the press. Often he can do away with the necessity of exposing the hand to remove the piece by using knockout strippers.

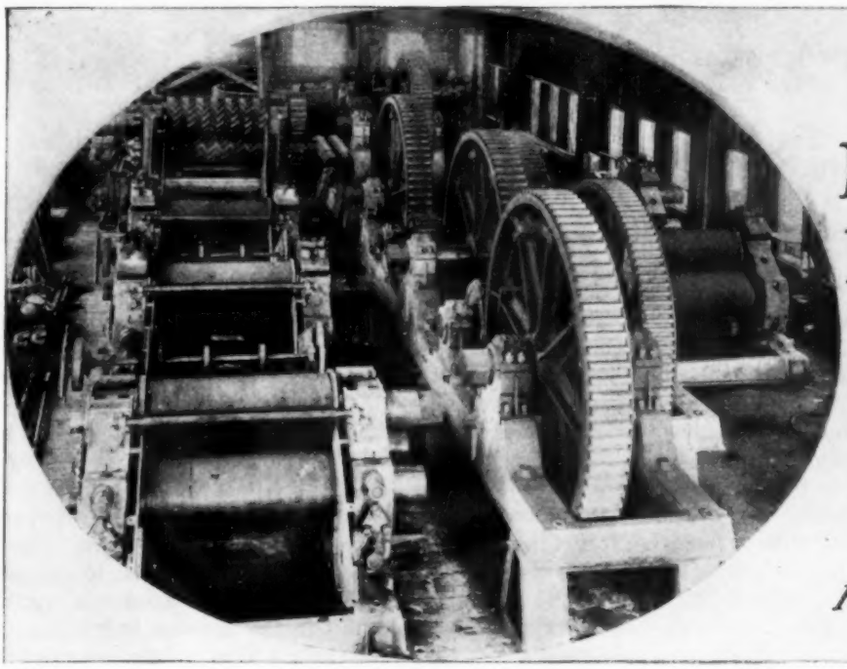
In blanking from strip stock of the wider widths the operator's hands are normally well away from the tools, but the thumbs and forefingers sometimes suffer through coming between the guide-pin bosses, which approach each other more closely with each successive grinding of the die. This is overcome to some degree by tapering the bosses.

Only One Real Successful Method

While safety devices will tend to lessen the number of accidents to some extent there is but one real successful method, and that is to keep the operator's hands out of the tools at all times. This condition was attained in one shop by the use of a loom-fixer's pliers, the long flat tongues of which are admirably suited to certain kinds of press work, and for more than five years these pliers have been in use in its press room. They are inexpensive, always ready, and above all they accomplish the desired result, as with their adoption the percentage of accidents fell to a negligible quantity. Broken and bent pliers were turned in for replacement much less frequently than men were formerly rushed off to the hospital in the works' ambulance.

By actual canvass in a room of 60 pressmen the voluntary use of pliers was unanimous, and no two men were handling the same shapes. With little effort their use becomes instinctive and habitual; one soon becomes accustomed to handling with accuracy and speed pieces of every describable shape.

Cases are few where they cannot be used to advantage, and the operator is no longer accustomed to working with indifference toward danger, and he never places his hand within the die to adjust strippers or clear a fouled piece without a momentary apprehension that prompts him to more caution than he would otherwise exercise.



Heavy Machinery Necessary for Sugar Making

By

Frank A. Stanley

ONE of the big firms of the South engaged in the construction of sugar-making machinery is Dibert, Bancroft & Ross, whose plant at New Orleans, La., has many features of interest. Many of the parts of sugar machines are very heavy. To those who are not familiar with sugar-mill machinery the crusher and roller mill shown in the headpiece will convey some idea of what one looks like. Some estimate of the size of the members may be had from the fact that the necks of the rolls used in sugar mills are often 18 in. or more in diameter by 22 in. or more in length. It is obvious that heavy housings and jaw boxes must be provided to accommodate these massive rolls and withstand the enormous pressure to which they are subjected when the sugar cane is passed between them.

Few of us who drop our sugar into our cups are aware that before it could be manufactured machinists had to build a gigantic machine weighing over a hundred tons and comparable to a rolling mill for armor plate.

Some of the big bearing shells are seen in Fig. 1, lying on the bedplate of a mill, presenting further evidence of the heavy proportions of the work as a whole. A roll being turned preparatory to grooving is shown in Fig. 2. The end of the roll shaft is formed with a large square by which it is driven when in place in its housings, and this squared end is utilized for rotating it in the lathe, a split dog in the form of a pair of bent straps serving to drive the work. The roll is supported in blocks which provide a bearing under each journal. Some of these are as large as 36 in.; in these the roll itself is cast-iron, forced onto a forged-steel shaft under great pressure. In Fig. 3 is shown a bottom roll and shaft with a roll diameter of 36 in. and length of 7 ft. across the face. The interior is bored a press fit for the shaft for a distance of about 26 in. at each end and the portion between is cored larger for clearance. The bore has two diameters to facilitate the pressing in of the shaft. The smaller end of the bore is 19⅞ in., the larger end 20 in., so that there is a clearance of ⅛ in. for the shaft when slid into place until its smaller end reaches the corresponding portion of the roll bore.

The roll and shaft are put together under 600 tons pressure, which is unusually high, as it runs up to 30 tons per inch of diameter or about three times that used for forcing locomotive drivers onto their axles and for other work of similar character.

The hydraulic press that is used to force the roll shell onto the shaft is a horizontal machine of 1000

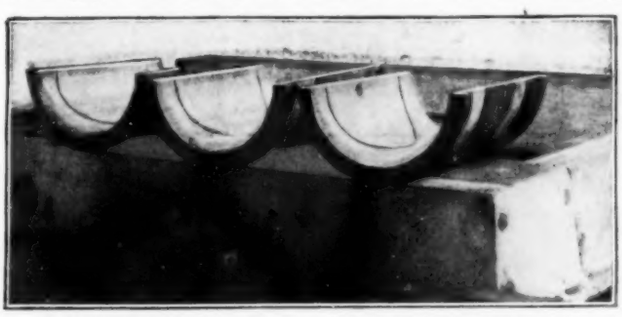


FIG. 1. BEARING SHELLS FOR MILL JOURNALS

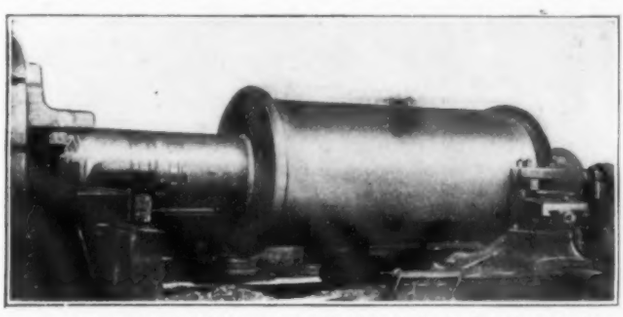


FIG. 2. FINISH-TURNING A BIG ROLL PRIOR TO GROOVING

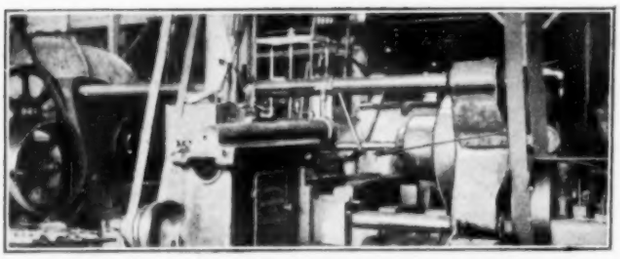


FIG. 4. A HOMEMADE 1000-TON HYDRAULIC PRESS

tons capacity, is homemade and of ample dimensions between end housings to admit work considerably longer than the roll illustrated by Fig. 3. The press is shown in Fig. 4, where the right- and left-hand housings are seen at either side of the shaping machine that occupies the foreground. The housings stand some 7 ft. from floor to top and they are tied together by four through bolts 6 in. diameter with nuts at the ends.

The roll illustrated in Fig. 3 is finished with a series

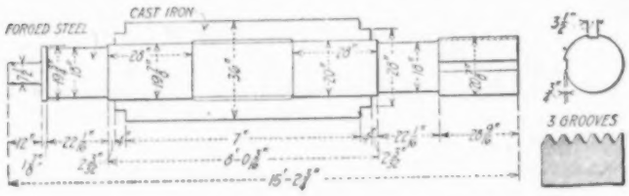


FIG. 3. ROLL AND SECTION OF GROOVES

of grooves around the circumference spaced three to the inch, though frequently the roll faces are grooved six or seven to the inch. The form of tool used in the grooving operation is shown in Fig. 5. It is a flat formed cutter with teeth similar to a flat chasing tool, except that the teeth are uniform instead of being beveled away at the leading end to provide a starting clearance. The tool is fed straight in by the cross-slide until the proper depth of groove is obtained and is double edged with cutting teeth on each side so that an economy in the steel blank is effected and there is always a suitable grooving edge available for the work.

The teeth are formed from the face to the back with uniform section, and as the top surface is ground away in sharpening there is no change in the tooth form. In plan the tool resembles a double-edged rack with teeth similar to a coarse-pitch U. S. Standard thread.

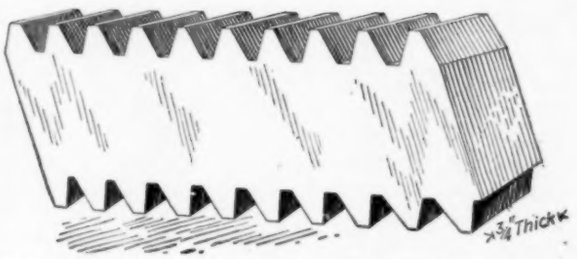


FIG. 5. DETAIL OF DOUBLE-EDGED GROOVING TOOL

There are various forms of grooves in different classes of rolls. Several types of rolls are shown in Fig. 6, the one at the top being cast with herringbone corrugations for crushing the cane as it first enters the mill. Underneath this is a shaft for a roll of the kind already described, and at the front of the pile is a finely grooved roll, which is one of the finishing set where the fine grooves act to squeeze the cane, and deeper grooves every few inches serve to carry away the juices. This latter roll is also of the construction referred to where the roll proper, or outer shell, is pressed upon a shaft for carrying the whole unit in the housing bearings.

The different types of rolls are very heavy units to handle and machine. The roll in Fig. 3 weighs when in place on its shaft about 14 tons, and the complete outfit of rolls in a nine-roll mill alone will run up to say 120 tons, this without the gearing, housing, etc., which in the total make up a massive piece of apparatus.

The machine shown in the headpiece has a length of approximately 75 ft. for the main bedplates, and some idea is therefore obtained regarding the sizes of the spur gears that operate the sets of rolls. These gears are 10 to 14 ft. in diameter by 12 to 16 in. face and will weigh 5 or 6 tons each. They are fitted on shafts 18 in. or more in diameter and are themselves built up in the form of gear rings mounted on a spider.

In Fig. 7 a cast-steel pinion is illustrated on the table of the keyseating machine. This pinion is one of the driving members in the gear train for the rolls and its proportions are well shown. This pinion weighs about 1½ tons. Its teeth have a circular pitch of 4.5 in. and a length of face of 14 in. Broad keyways are used in this class of work, and referring specifically to the bottom roll in Fig. 3, which is illustrated with two keyways in the end of the shaft, these keyways are 3½ in. wide

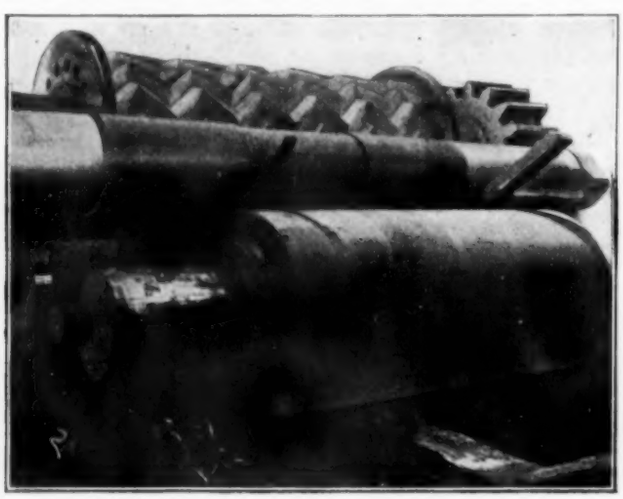


FIG. 6. SEVERAL TYPES OF "ROLLS"

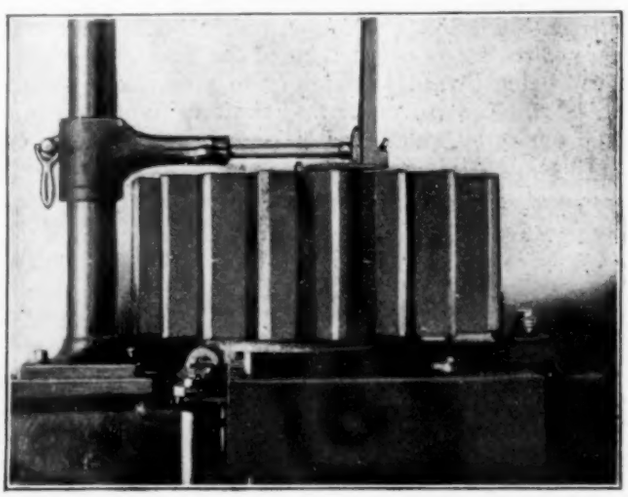


FIG. 7. CUTTING A KEYWAY IN A CAST-STEEL PINION

by ¾ in. deep. They are planed into the shaft at 90 deg. to each other and are cut clear across the enlarged end of the shaft, which is $28\frac{9}{16}$ in. long.

The top roll in each set of three is the driver. The shaft in the top roll extends 10 in. beyond the ends of the other shafts and is formed with a square as large as the shaft diameter will permit to receive the driving chuck, or cathead, on the short shaft that extends across from the gear train. The connections for the rolls and gear train are therefore very similar to the drive employed on roll sets in steel mills.

In some instances a herringbone form of gear tooth is used and it has been found to impart smoothness of action.

Manufacture of Tungsten and Molybdenum

By PAUL McJUNKIN

A BRIEF description of the method of manufacturing tungsten and molybdenum wire may be of interest to those who are not acquainted with it. The process is essentially the same for both metals.

The successful manufacture of wire of these materials required extraordinary perseverance in the various steps, but as is often the case in even the most remarkable technical achievements it appears that nothing essentially new was employed. This should not detract from the credit due to those who had the ability and the resources necessary to achieve the remarkable result of obtaining wires of unusual ductility from materials previously considered nonductile.

How Tungsten Wire Is Made

Tungsten wire is made by reducing tungsten trioxide (WO_3), which has been purified, to metallic tungsten powder, which, with a small amount of a binding material, is compressed by a mold in a heavy hydraulic press to a stick of square section, usually about 20 cm. long by 1 cm. square. This stick must be carefully handled until it has been brought to an extremely high temperature in an electric furnace, which temperature can be attained only by using a heating coil of tungsten or molybdenum protected by an atmosphere of hydrogen or nitrogen. After this treatment the stick has sufficient mechanical strength to permit its being mounted vertically between heavy water-cooled copper clamps in a water-cooled vessel in which an atmosphere of pure hydrogen can be maintained. An electric current is then passed through the stick of tungsten, bringing it nearly to the fusing temperature of the metal. At this temperature the pressed stick consolidates into a homogeneous rod, now called an ingot, having contracted considerably both in length and thickness, and, though still very brittle when cold, having very considerable mechanical strength.

The next step is perhaps the most important, since it is here that the extremely brittle mass of tungsten is given a fibrous structure, permitting it eventually to be drawn into wire. The successful introduction of this step was undoubtedly due to the persistence of A. J. Langelier of Providence, R. I., who has had many years of experience in the swaging of metals. The swaging machine contains a pair of dies which when rotated deliver a series of rapid blows from different angles on a rod of metal passed between them, thus reducing the diameter and giving to it the mechanical working which results in the elongation of the crystals of the metal and consequently a fibrous structure. In the case of tungsten and molybdenum this can only be accomplished with the ingot at a very high temperature and in many steps with a very small reduction in diameter at each step. By the time, however, that the ingot has been reduced to a diameter of about 1 mm. it is possible to begin actual wire-drawing operations.

The wire drawing is done on specially constructed drawing machines, using diamond dies, though to a small extent special alloy dies have been successfully used for the larger sizes. During the first passes through the dies both the wire and the dies must be kept quite hot, the temperature being reduced as the diameter of the wire decreases. As a lubricant for drawing aquadag is applied to the rod during the swaging and adheres to the wire throughout the drawing process, giving it a jet-black appearance, hence the term "black wire" applied to the unannealed and uncleaned wire as it comes from the dies.

Coiling the Spiral

For coiling the spiral filaments used in gas-filled lamps and for use with the "form wound" method of filament mounting tungsten wire is generally used unannealed, while for winding the filament on the stem directly from the spool it is generally annealed. Usually the unannealed, or "black," wire is very curly, due to the die not having been exactly symmetrical or the line of drawing not exactly coinciding with the axis of the die. If the annealing be carried far enough the wire will be entirely free from kinks or curls, but the tensile strength, which is very high in the "black" wire, is greatly reduced by annealing so that a partly annealed wire is most suitable for lamp manufacture.

Tungsten and molybdenum are also made in the form of sheets or strips, which are produced by subjecting the ingots to hot rolling. For some purposes the rods resulting from the swaging of the ingots are directly of value. For other purposes shapes molded from the metal powder and intensely heated in an electric furnace are useful.

Larger units of production are being constantly attained and improved methods of manufacture developed, both bringing nearer the more general use of these metals in the world's industries.

Properties

Tungsten, and to a lesser extent molybdenum, is distinguished by several characteristics. Both are extremely resistant to corrosive or other chemical action. The tensile strength of wires is enormous, in the case of fine tungsten wires from two to three times that of the best steel wires. The melting points are

extremely high. They are generally very hard, slight alloying and proper treatment making them excessively so. The following data summarize these and other properties of tungsten which may be of interest:

Density, 19 to 21.4, depending on the method and extent of mechanical working in its preparation.

Tensile strength, 300 to 425 kgm. per square millimeter (425,000 to 600,000 lb. per square inch) for wire which has had considerable mechanical working, hence depending largely upon the size of the original ingot.

Young's modulus of elasticity 42,200 kgms. per square millimeter (60,000,000 lb. per square inch) for wire in which the fiber has been fully developed.

Melting point, 3177 deg. C. (5722 deg. F.).

Thermal conductivity, 0.35.

Coefficient of expansion, 0.0000043.

Specific heat, 0.0357.

Electrical resistance at 25 deg. C. (77 deg. F.): 6.2 microhms per cubic centimeter (37.5 ohms per mil foot) for hard-drawn wire to 5.0 microhms per cubic centimeter (30 ohms per mil foot) for fully annealed wire.

Temperature coefficient of electrical resistance (0 to 170 deg. C.) 0.0051.

Applications

The greatest quantity of both tungsten and molybdenum is used in the manufacture of alloy steels, for which purpose the metals are reduced in the form of ferrotungsten and ferromolybdenum.

By far the leading use of the pure metals is that which first prompted their production, tungsten for the filaments of incandescent electric lamps and molybdenum for the anchors or hooks which support the tungsten filament. Certainly the purest tungsten, if not the first production, was that secured by the colloidal process of Dr. H. Kuzel. That which made the tungsten lamp of today practicable was the production of tungsten in the form of wire, both because of the comparative cheapness of the filament itself and the lower cost of making the lamps because of the greater mechanical strength of the filaments.

Most people who are familiar with tungsten and molybdenum believe that on account of their peculiar properties their use is only in its infancy and is destined to undergo enormous development, and that these metals merit the very serious consideration of men engaged in many diversified lines of industry. Indicative of this diversity a few applications will be mentioned, some of which are already extensive while others are only in the experimental stage and some must await improvement and cheapening of production for extensive use. Tungsten, and to a lesser extent molybdenum, has been used with great advantage over the metals previously employed in the manufacture of incandescent electric lamps, because of the very high melting point and low vapor tension at high temperatures.

The Use of Tungsten Disks in Wireless Apparatus

Tungsten disks are extensively used for spark gaps in wireless apparatus, and the metal has almost entirely replaced platinum for the contact surfaces of vibrators in ignition coils and many other electrical instruments. For some of the more important controls of airplanes, cables made of tungsten wire are largely used instead of steel because of their greater strength and because being entirely unaffected by moisture or corrosive gases there is no possibility of the development of a defect through any slight imperfection or abrasion of the protective coating applied to steel cables.

Electric furnaces operated at very high temperatures are becoming more important in many industrial processes. The use of tungsten and molybdenum wire and ribbon for the heating coils permits of operation at a temperature several hundred degrees higher than is possible even with platinum windings. X-ray tubes have been made much more powerful through the substitution of tungsten for platinum as a facing for the targets because of the higher temperatures permissible.

The Development of the X-Ray

This development of X-ray apparatus has made it practicable to apply these rays to many industrial processes, such as the hastening of chemical reactions usually dependent on sunlight, the inspection of metals for imperfections, the sterilization of boxed cigars against destructive insects, the curing of patent leather, the coloring of glass for optical purposes, etc. On account of its hardness, toughness and of its not being affected by local heating tungsten needles have largely replaced steel needles in phonographs, being serviceable for a hundred reproductions without injury to the record.

Tungsten wire has been used to some extent as strings for musical instruments with much satisfaction. Its weight, about two and a half times that of steel, increases volume of sound and it has been suggested, though not to my knowledge tried, that in consequence pianos may be made of either smaller size for a given volume of sound or having a greater volume of sound from present sizes. Because of its great tensile strength and that it can be readily drawn to diameters as small as 0.0004 in. tungsten wire is used as suspension wires for scientific instruments and as invisible suspension and control wires for advertising novelties and theatrical effects. Certain easily made alloys of tungsten are extremely hard and will doubtless come to be largely used for cutting tools and wire-drawing dies.

It is hoped that these examples may at least suggest many other uses.

Tungsten Wire Data

The following tables are based on average data for the wire generally used for filaments for electric lamps. Necessarily the figures for resistance are only approximate, as these vary with the density and degree of annealing of the wire. They are, however, accurate in that they show the correct relations of wires of different diameters:

TABLE OF RELATION BETWEEN DIFFERENT WIRES

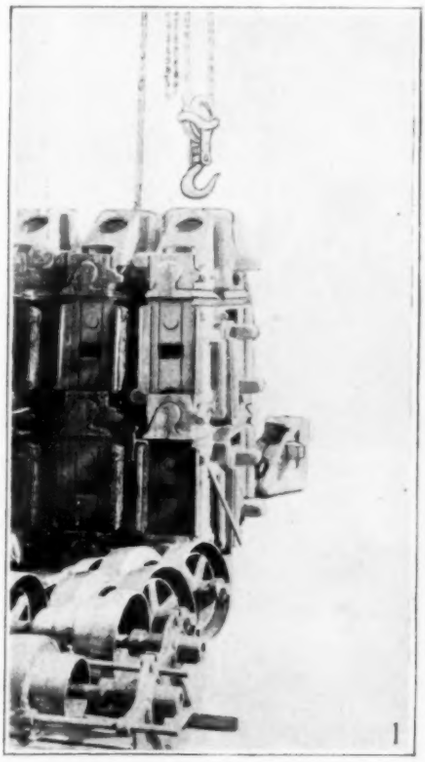
Diameter		Reistance Cold in Microhms		Length	
Mm.	In.	100 M.	1000 Ft.	M. per Kg.	Ft. per Lb.
0.010	0.00039	76,500	233,500	665,000	990,000
0.015	0.00059	34,000	104,000	295,000	440,000
0.020	0.00079	19,200	58,300	166,000	248,000
0.025	0.00091	12,250	37,400	106,000	159,000
0.030	0.00118	8,500	25,800	74,000	110,000
0.035	0.00138	6,250	19,000	54,000	81,000
0.040	0.00157	4,800	14,500	41,500	62,000
0.050	0.00197	3,060	9,400	26,500	39,700
0.060	0.00236	2,130	6,500	18,500	27,500
0.070	0.00276	1,560	4,750	13,600	20,300
0.080	0.00315	1,200	3,650	10,400	15,500
0.090	0.00355	945	2,880	8,200	12,200
0.100	0.00394	765	2,330	6,650	9,900
0.125	0.00492	490	1,500	4,250	6,350
0.150	0.00590	340	1,040	2,950	4,400
0.175	0.00689	250	760	2,170	3,240
0.200	0.00787	192	583	1,660	2,480
0.300	0.01180	85	258	740	1,100
0.400	0.01570	48	146	415	620
0.500	0.01970	31	94	266	397

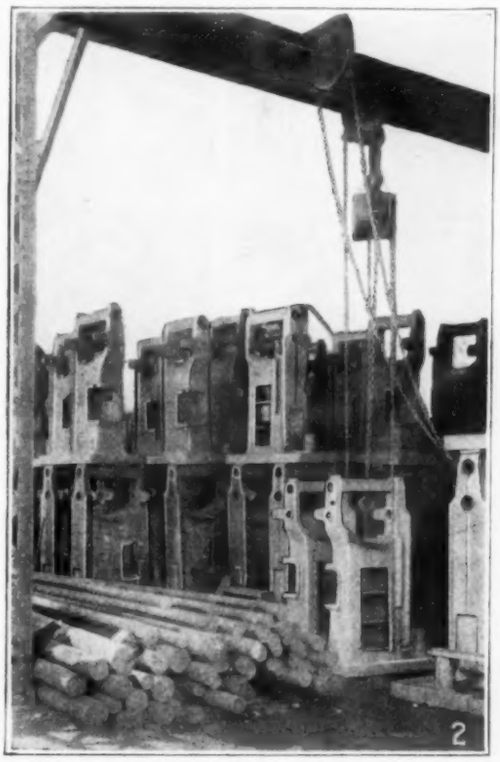
Building the Kempsmith Milling Machine—I

By M. E. HOAG

Some of the operations followed in the construction of a well-known milling machine, as well as a few details in regard to handling stock and routeing of work through the factory, are here presented.

THE success of a modern machine-tool plant depends not only on good equipment, competent workmen and financial backing, but the loyalty of the workmen and the system of handling the work both from the viewpoint of the offices and the shops are important factors to be considered. The shops of the Kempsmith Manufacturing Co., Milwaukee, Wis., present an excellent example of the up-to-date machine-tool manufacturing plant, whose ability to meet the present trying conditions should be of interest to others.





FIGS. 1 AND 2. STORAGE OF CASTINGS FOR SEASONING

The shops are single-story buildings with sawtooth roofs. The floors were originally of concrete, but they did not prove satisfactory on account of the accumulation of dust and grit which could not be prevented from getting into the bearings of the machinery. It was also believed that the health and efficiency of the workmen were impaired by standing on the cold concrete floors, so they are now overlaid with wooden paving blocks. The trouble from dust has been eliminated and the men have been found to be more efficient and able to stand for longer periods when occasion demands.

The apprenticeship system is in vogue in these shops, and that it is very successful is evidenced by the fact that the department foremen have with one or two exceptions risen from the ranks of the apprentice.

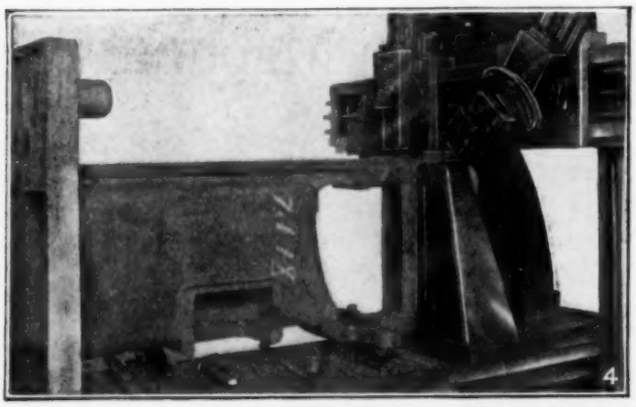
Two railroad spurs at one side of the shops afford ample transportation facilities, large loading platforms with cranes and storage facilities being provided, partial views of which are shown in Figs. 1 and 2. At the opposite end of the storage platform shown in Fig. 1 is a building which is devoted entirely to the storage of countershaft parts.

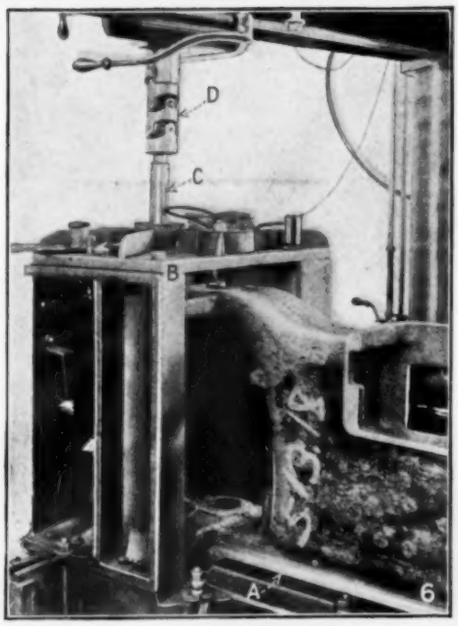
The stock enters the shops from the storage platforms and makes a complete circuit of the plant, passing from one machine or group of machines to another and to the assembling, testing, inspecting and painting departments until the completed machines finally reach the shipping department and are ready to leave the shop at practically the same point that the raw material entered.

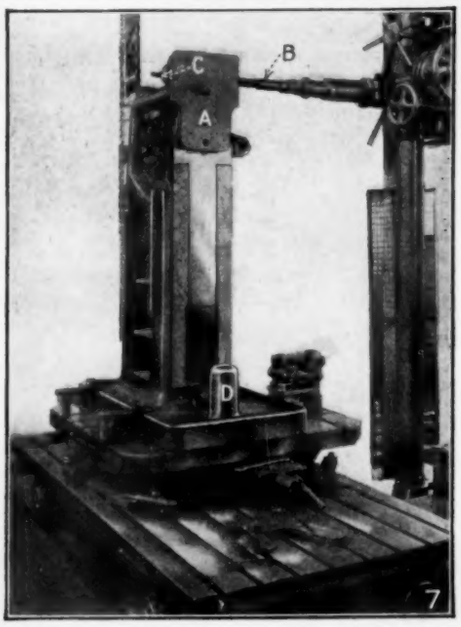
A system of unit assembling is followed, whereby the various parts such as columns, knees, tables, etc., are assembled, the sections passing thence to the final assembling department, where they are brought together to form the complete machine. In the superintendent's shop office there is installed a system of boards by which accurate track is kept of stock in process and storage, so that a glance is sufficient to determine the department in which any lot of parts is located, data of these movements being taken from the operation tags and time cards turned in, as each operation is completed, and transferred to plugs on the boards. The boards are divided into cross-sections, a straight-edge on each board aiding in securing correct location. An idea of the general construction of these boards is shown in Fig. 3.

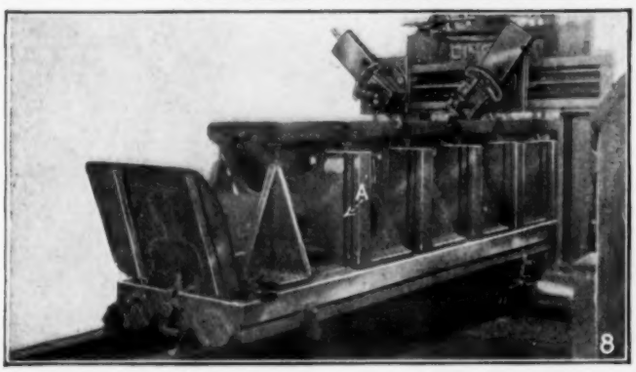
Standard jigs are used for all planing, milling and other machining operations, which insures uniformity of parts and of finished product. A few of these jigs will be described in this article.

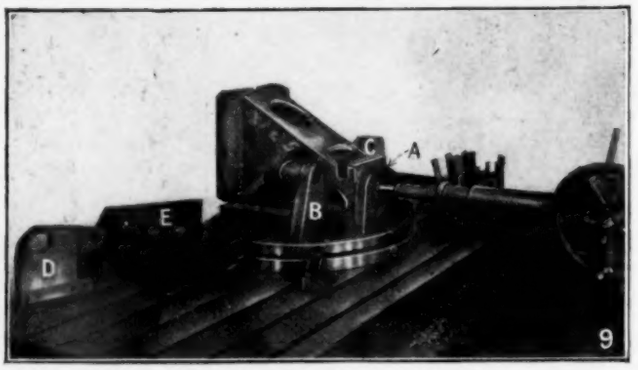
The first operation on the columns is planing the bearing surfaces for the knee, as shown in Fig. 4. For this operation the base of the column is allowed to rest on the planing-machine table, while the upper part, which carries the arm, is held by setscrews and suitable clamping blocks in the jig, the work being indicated and leveled up as in regular practice. All flat surfaces, as well as the Vs, are finish-planed at one setting, this being rendered practicable by long open-air seasoning of the castings. After the planing operation the columns

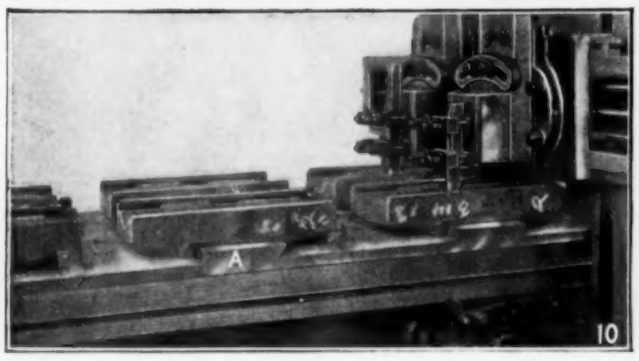


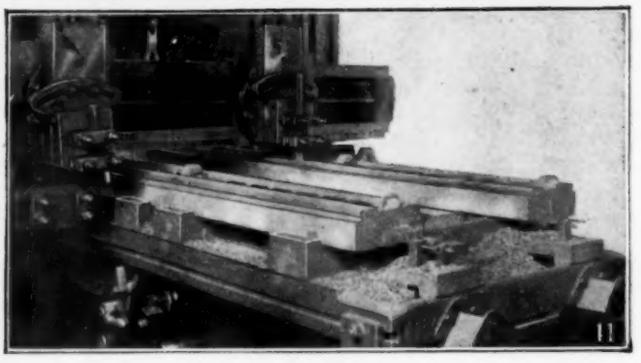












FIGS. 4 TO 11. PLANING, BORING AND SCRAPING OPERATIONS

Fig. 4—Planing the machine column. Fig. 5—Scraping the face of the column. Fig. 6—Boring holes for spindle and overarm. Fig. 7—Boring the arm clamping holes. Fig. 8—Planing the knees in gangs. Fig. 9—A turret jig for boring the knees. Fig. 10—Planing the saddles. Fig. 11—Planing the work tables

are scraped to standards as seen in Fig. 5, which shows a surface plate fitted with trunnions and bail and attached to a chain block so that the workman can handle it easily without a helper. This scraping gives a true bearing surface from which all future locations and gagings are taken and insures the alignment of all parts.

To drill the arm hole, spindle holes and back gear-shaft holes the column is placed face down with the scraped surface resting on and clamped against the ways of the jig as seen at *A*, Fig. 6, the head of the column being located in the bushed portion *B* of the jig

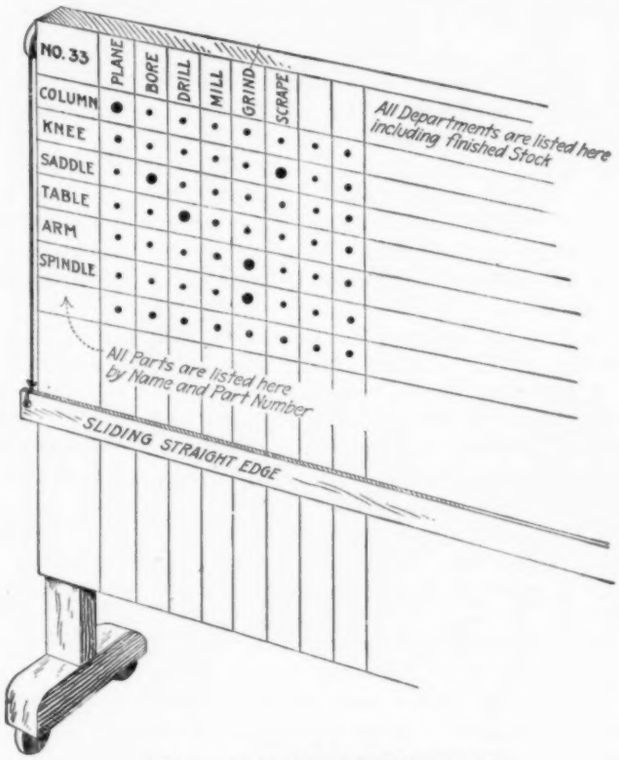


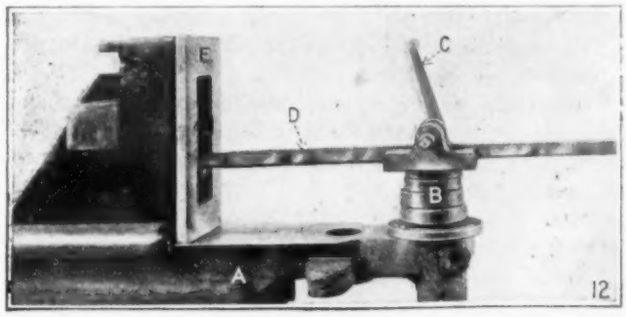
FIG. 3. WORK PROGRESS BOARD

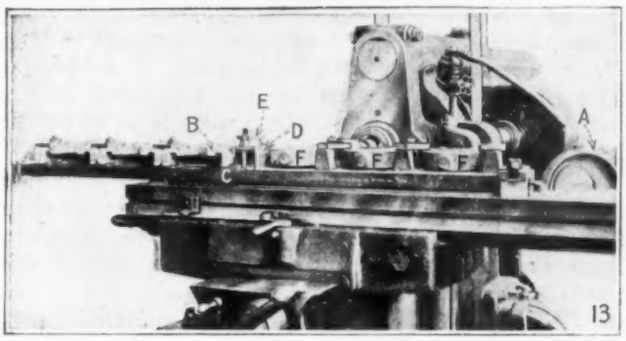
under a radial drilling machine. Movable slip bushings and a boring bar *C* with a universal joint *D* render the boring of these holes a simple operation.

To bore the arm-clamping-screw holes the column is placed on the turntable car of a Pawling & Harnischfeger horizontal boring and drilling machine, as shown in Fig. 7. The jig *A* is clamped to the column, being located by plugs that enter the holes already bored for the spindle and arm, and serves to guide the boring bar *B* by means of two slip bushings, one of which may be seen at *C*. The boring, facing and tapping of the boss *D*, which supports the nut for the elevating screw, is done in a similar manner, the jig being located by and clamped to the ways on the front of the column.

The knees are planed in lots of eight, jigs being used to secure proper location and alignment, as shown in Fig. 8. The column bearing is planed first, the castings being clamped in the jigs by the Vs that receive the saddles. After planing all surfaces in this position the position of the castings is reversed, and they are clamped with the finished surfaces against a second set of Vs in the jigs shown at *A*, thus bringing all of the bearing surfaces square with each other and in perfect alignment. They are then placed on a horizontal drilling machine as shown in Fig. 9, and the various holes bored. The jig used for this work is of the turret type, so that it can be indexed for drilling all the holes at one setting and thus insure their proper relation. As shown in the illustration there are four bushings in the bushing plate *A* and one in plate *B*, all the holes covered by these five bushings being bored with the jig in the first position. The top plate is then indexed through an arc of 40 deg. and another hole bored through a bushing in *C*, after which it is turned 180 deg. from the original position, and by setting the two auxiliary bushing plates *D* and *E* into the back of the jig the remaining holes are bored. It should be noted that for all machining operations the various parts are jigged and clamped by the Vs. After planing, these surfaces are all scraped true before any boring operations are performed, which insures perfect alignment of the bored holes with the bearing surfaces.

The method of setting up the saddles for planing is shown in Fig. 10, each jig *A* being tongued and bolted to the planing-machine table. The work is reversed





FIGS. 12 AND 13. OTHER OPERATIONS
Fig. 12—An aid to scraping. Fig. 13—Milling trunnion rings

upon these same jigs for the second-planing operation. The tables are handled in much the same way, as shown in Fig. 11. Anyone who has done much scraping on heavy work knows that much energy is wasted in working heavy parts together for the purpose of locating the bearing spots. To reduce this labor the device shown in Fig. 12 is in general use in the Kempsmith shops and it greatly facilitates the scraping-in of heavy parts. In the illustration the machine column *A* is laid face up on the floor, and the piece *B*, which carries a shaft and pinion on the handle *C*, is bolted into the arm hole. The rack *D* carries a sort of clevis on one end by which it is loosely attached to the knee *E*. It is not difficult for the workman to slide the knee back and forth on the column by turning the handle *C*.

The bronze trunnion rings, one of which is shown at *A*, Fig. 13, are milled on the ends as shown at *B* and are

handled in lots of three on the jig *C*, which consists of a cast-iron plate with suitable locating and clamping blocks and a collar *D* bored true and central with the bedplate which slips over the stud *E*, this stud being fastened into one of the T-slots in the milling-machine table. The jig plate can thus be turned end for end about the stud *E*, and it is provided with a hinged tongue or locking device at each end fitting into the central slot in the table to locate the jig plate in alignment in either position. When three pieces *F* have been milled, that end of the jig is swung past the cutter and the other end of the jig which has been loaded during the milling of the first three pieces is brought into position. Thus an almost continuous milling operation is maintained with a comparatively simple jig.

The Trouble Man Discovers a New Kind of Chain

By Philip C. Gunion

"Did you hear how Tom White and Bill Grace are good friends now?" asked the Trouble Man as he stopped before my desk one morning.

Tom White was our young mechanical engineer and a college graduate, and he and Bill Grace, our master mechanic, a graduate of the famous school of experience, had never got along very well together, so I was interested in hearing that they were now friends and in hearing the reason.

"No," I replied, "I have not heard about it, so go the limit."

"Well you know how them two never could agree about anything. It was Bill's fault mostly, because he was always sneering at the book learning that Tom had and trying to catch him up on things. Bill didn't like it because such a young man as Tom stood in so well with the super. He was always starting fool arguments.

" 'Perfessor,' Bill would say, knowing that Tom considered himself a practical man and therefore hated to be called that, 'Perfessor, I would like to have you answer me a question and explain to these gentlemen here a few scientific facts.'

" 'Shoot,' Tom would come back pleasantly, 'I can explain some things and others I can guess at. What's troubling you?'

" 'Well, I would like to know whether it is possible to float a battleship on a drop of water,' replied Bill with a wicked wink at the gang.

" 'Of course not,' says Tom, 'that's a foolish question.'

" 'It can be done though,' insisted Bill.

" 'How?'

" 'Well, you build a drydock that fits the ship skin tight so there's no room between the dock and the sides of the ship for any air and then you put in the dock one drop of water and lower the ship into the dock and the water spreads out in a thin skin and floats the ship. It's simple,' explained Bill.

" 'Simple enough,' admitted the gang.

" 'It can't be done,' insisted Tom, saying that some man with an Italian name had a law that a ship had to displace its weight in water to float. He said that Bill's one drop of water would be squeezed out so fast it would never know what hit it.

" 'What's this guy Avygardro know about it?' asked Bill. 'Did he ever try it? My guess is as good as his'n.'

"And that is just a sample of how Bill would try and make out Tom didn't know anything, and Tom would get so excited and mention such a lot of rules and laws that we never heard about that the most of the boys figured Bill was the original wise guy.

"Secretly, though, Bill knew Tom was way ahead of him on the reason for things and fast catching up on practical things. Bill used to take a peep at Tom's books when the lad was not around and pick up lots of things to talk to the boys about.

"You know Bill has to make out specifications for materials he needs, and instead of asking Tom to help him he would look into Tom's notebooks to see whether to judge machine oil by the color or by the taste, and how strong steel is, and the like.

"Tom found it out and played a little trick on him. He heard Bill talking about a new length of chain for the couterweight on the big elevator door, and Bill was asking one of the foremen how you specify how strong a chain ought to be. He didn't know either so Bill said he would look it up.

"Tom beat him to it though and made a page in his notebook called 'Chains' and wrote 'Chain is specified in pounds per foot.'

"Bill read it when he got a chance and says to the foreman: 'Chain is specified in pounds per foot. That counterweight is a 100 lb., so I will need a good strong chain that will carry 100 lb. per foot.'

" 'Right,' says the foreman.

"So that's how the specification went into the super, and he roared to have Bill sent to him at once when he saw it.

" 'Are you trying to kid me, Grace?' he demanded.

" 'No, sir,' trembled Bill.

" 'Just what do you mean by chain 100 lb. to the foot then? I suppose 2 ft. of your chain would hold 200 lb. and 3 ft. 300 lb., and so on?'

"Bill was too surprised to answer, but Tom, whose desk was near by, came to his rescue. 'You only wanted a foot of chain, didn't you Bill?'

" 'Yes sir,' says the bewildered Bill to the super, one foot's enough, sir.'

" 'And that foot of chain must hold 100 lb.,' explained Tom.

" 'That's different,' says the super, cooling down. 'I thought you were trying to get funny. That's all, Grace.'

"Bill came up to where Tom was working in the shop a little later in the day and says curiously. 'Why did you get me out of that mess with the old man, Tom?'

" 'Because I and your own pig-headedness got you into it,' replied Tom, 'and because I like you, Bill.'

" 'Well I'm damned if I know why you do when I have ragged you so much. But that liking goes double and I am with you from now on. It don't bother me any more that I am still going to be just a master mechanic when you're the super,' says Bill humbly.

"And Tom's sure to be the super some day," added the Trouble Man earnestly.

"Nothing can keep a man like that down," I replied, chuckling at the 100 lb. per foot chain as I began to check the payroll.

Grinding Accurate Profile Gages by Means of Master Plates

BY HERBERT M. DARLING

The accurate grinding of irregular-shaped profile gages may be simplified in many cases by the use of suitable master plates. This is especially true when it is to be done in a shop that is only moderately well equipped for doing work of this character.

BY THE use of master plates many gages of irregular profile may be ground in the bench lathe. The gage shown in Fig. 1 is used for the purpose of checking the inside profile of a rifle band, and by reference to the illustration it will be noticed that the gaging surfaces are made up of five separate radii struck from as many different centers. The essential dimensions must be maintained within a tolerance of 0.0001 inch.

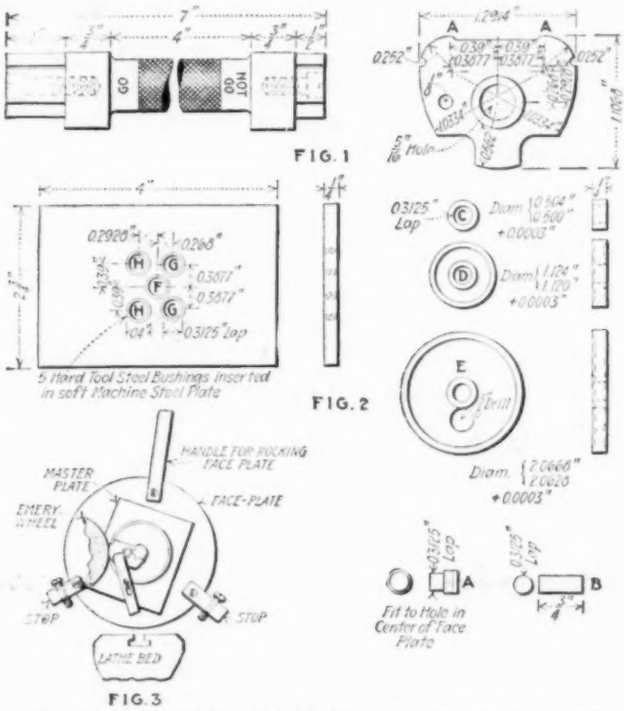


FIG. 1 FIG. 2 FIG. 3

FIGS. 1 TO 3. GRINDING ACCURATE PROFILE GAGES

Fig. 1—The gage to be ground. Fig. 2—The master plate and buttons. Fig. 3—Method of using the master plate

The gages were roughed out of tool steel and hardened, sufficient stock being left for grinding on the outside and for lapping the holes. As the same tools and methods were used in finishing both gages only one will be described.

Let us take, for example, the no-go gage, which is 0.004 in. larger over all than the go gage. First I made as accurately as possible the master plate shown in Fig. 2. The bushings all have the same sized holes, and are spaced to the same center distances as the centers of the radii of the gages to be ground. The faceplate of the bench lathe has a true hole $\frac{3}{8}$ in. in diameter in its center. The larger end of plug *A* is made to fit tightly into this hole while the smaller diameter is lapped to a wringing fit in the bushings in the master plate. The plug *B* is also made to this latter size.

The three buttons *C*, *D*, and *E* are made up from tool steel, are hardened and ground on the diameter, and the sides are ground parallel. The holes in these three buttons are lapped to exactly the same size as the bushings in the master plate. The radius of each button is made to correspond with one of the radii to be produced, plus 0.0003 in. in each case. That is *C* has a radius of 0.2523, *D* of 0.5623 and *E* of 1.0337.

After hardening the gage the holes are lapped out (the $\frac{1}{8}$-in. hole being unimportant as it is only for a dowel pin). The $\frac{5}{16}$-in. hole must be a wringing fit on the plugs *A* and *B*.

A plug is now turned and ground to exactly 0.3125 in. in the bench lathe. Leaving this plug in place in the draw-in chuck the gage is wrung onto it and the face is ground true and square with the hole.

Grinding the Radius

The next step is to grind the 0.562 radius. For this operation the disk *C* is selected, its periphery coppered, and it is wrung onto the 0.3125 plug, which has been left in place in the lathe. The gage is now pushed onto this plug up against the disk. The grinding attachment is then placed in position on the cross-slide, and while rocking the lathe spindle backward and forward by hand the grinding wheel is traversed across the work until it touches the coppered surface of the disk. As the disk is 0.0003 in. large on its diameter the work will now have from 0.0001 to 0.00015 in. to lap on this radius.

The gage is then lined up on the surface grinder and the flat surfaces *A*, Fig. 1, ground to bring the over-all dimension to 1.1068 inches.

The Master Plate

We now come to the point where the master plate is used. We start with one of the large radii—1.0334. The master plate, which has several screw holes (not shown) for clamping purposes, is first clamped against an angle iron on a surface plate, and the plug *B*, Fig. 2, pushed into the bushed hole *F*. The plug *A* is pushed through one of the holes *G* from the back of the plate. The disk *E* after being coppered is pushed onto this plug, the $\frac{3}{8}$ drilled hole near its center going loosely over the plug *B*. The gage is now pushed onto *B*, and by means of an indicator the surfaces *A*, Fig. 1, are lined up parallel with the sides of the master plate. The master plate is now located on the faceplate of the lathe by means of the plug *A*, which fits the center hole of the latter.

After making the clamps secure, stops are set to prevent turning the lathe spindle too far and the radius is ground by rocking the faceplate and traversing

the grinding wheel until it touches the coppered disk. The setup is shown in Fig. 3. The work is now relocated and the other large radius ground in the same manner.

The next step is to grind the 0.252-in. radius, for which the two holes *H* are used in place of *G* and the 0.504-in. disk instead of the larger one. When the gage is ground it will have about 0.00025 in. on its over-all dimensions to lap, after which it is ready to assemble on the handle with a fillister-head screw and dowel pin.

The other end, or go gage, is finished in the same way. As the center distances are the same as in the first gage the same master plate is used, and the same disks are made to serve by first grinding down their outside diameters to a size 0.004 in. smaller.

Drawing a Shell From 1-In. Boiler Iron

By G. R. SMITH

In these strenuous times when the efforts of everyone are being strained toward greater production some seemingly impossible feats are being accomplished. Among these the drawing on an ordinary double-action or draw-press of metal as heavy as 1 in. in thickness is worthy of notice.

WE NEVER know until we have tried what may or may not be done in the way of forming heavy sheet metal into peculiar shapes. A few years ago heavy shell drawing with a common double-action draw-press was unknown, and I well remember the expressions of disbelief when steel coffins were first drawn up from ¼-in. stock, soon to be followed by the drawing of 55-gal. steel barrels from $\frac{3}{16}$- and ¼-in. stock. No little wonderment was excited, even in the face of these achievements, when a press was recently built to draw an automobile body; but hitherto no one, so far as I know, has attempted the drawing of 1-in. boiler plate even in the smallest shapes.

Production Doubled

While the operation here described might possibly be called a forging by those not familiar with this class of work from the fact that it is drawn while hot, it is not a forging in any sense of the word, but is a true drawing operation on a toggle-action draw-press. This operation is one of the results of the recent speed-up request in connection with the shipbuilding program, and the production has been doubled several times with material reduction of cost.

The shell, or flange, shown in Fig. 1, was originally designed as a coupling flange to be used in boiler and engine work. But since the cost of their production has been cut they have been in great demand in the shipbuilding industry for oil caps, stanchion and equipment bases, lead collars, etc., and are drawn in various sizes from different thicknesses of metal.

These flanges were first made from steel blanks with the center tapped out and short lengths of pipe screwed in, but this method was unsatisfactory besides being slow and costly. It also required several sizes of pipe for the different sizes at flange.

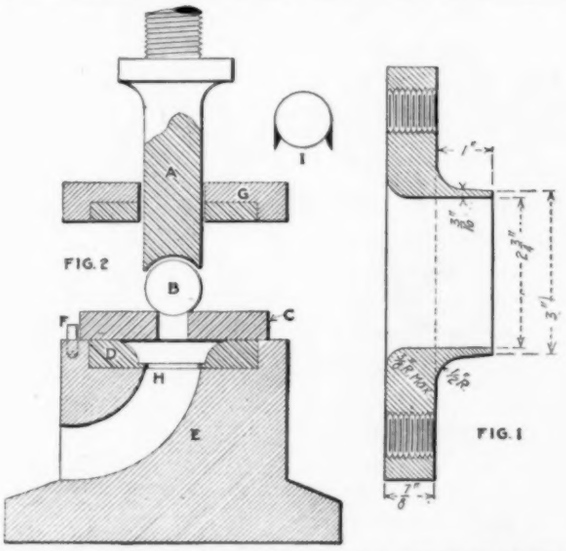
I might dwell at length on the construction of the tools for this operation, the various forms of punches that were tried out, and the many difficulties encountered before success was attained, but I feel that this would be needless, as we are interested only in the tools that were ultimately successful.

In Fig. 2 is shown a cross-section of the tools used with a blank in position to draw. The punch *A* is cupped at the bottom end to fit the steel ball *B*, which is the actual drawing punch, and is ⅛ in. smaller in diameter than the ball. The ball is made of tool steel, and after several attempts with balls of varying hardness it was found to be more satisfactory to leave it unhardened. The diameter of the ball determines the size of the hole in the flange.

The blank is shown at *C*. The die *D* is of tool steel and hardened. It is set into the cast-iron die block *E* and several pins, one of which is shown at *F*, locate the blank in position for drawing.

The blank holder *G* is of cast iron with an inserted ring of hardened steel.

It will be noticed that the die *D* has a shearing edge



FIGS. 1 AND 2. FLANGE DRAWN FROM 1-IN. BOILER IRON AND TOOLS FOR DRAWING HEAVY FLANGE

at *H*. The hole in the die at this point is just large enough to pass the ball, which, as it passes through the die, cuts off any surplus stock, carrying the scrap ahead of it in the form of a ring as shown at *I*. The ball then passes out through the curved opening in the die block, dropping into a pail of water where the sudden chill and contraction of the ring of scrap causes it to loosen so that it is easily knocked off the ball with a light hammer.

The blanks are cut out of the plate with the oxy-acetylene welding torch, and the center hole is cut out in the same manner.

The blanks are brought to a bright cherry-red heat

in an oil furnace located conveniently near the press and are passed to the die while still red hot. After the hot blank is placed in position and the ball placed on the hole a small handful of granulated charcoal is shaken around the edge of the center hole and the ball, this acting as a lubricant allowing the ball to be forced through easily, leaving the hole smooth.

In heating the blanks care should be taken to avoid scale as much as possible, each blank being drawn just as soon as it is hot enough. The longer it is left in the furnace the more scale will form, and while no great trouble is experienced in the dies the result is a poor shell.

Getting a Continuous Run

By placing a cold blank in the furnace for each hot lank taken out a continuous run may be had, and after few blanks are run off the operator can judge the amber of blanks that will be required in the furnace. By throwing the drawn shells in a pile on a sheet of stock or a concrete bed and allowing them to cool slowly they will anneal, and may be machined very easily if required.

The production is at the rate of about one hundred an hour. The press used for the work is a Bliss No. 14-B, but there are a number of toggle-action draw-presses of this size and general style on the market that would meet the requirements.

Locating Knocks in Motors

By B. Z. Reiter

One of the intricate problems a mechanic has to deal with is that of distinguishing between and locating engine or motor knocks. To do this a listening apparatus as shown in the sketch is useful. It is made of a ¾-in. copper tube about 8 in. long with a steel point welded in one end. In the other end a steel rod is inserted making a snug fit in the copper tube. A telephone receiver is then connected by means of wire to the end of the steel rod to complete the listening apparatus.

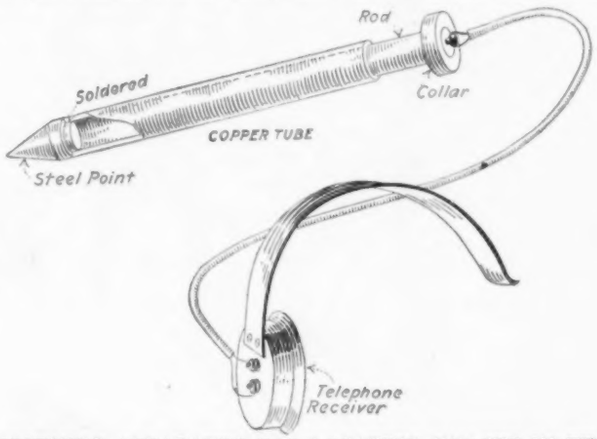
When trying to locate a knock the steel rod is pulled out about 4 in. By touching the motor with the steel point on the places where the trouble is expected and keeping the receiver to the ear the knocks can be heard distinctly while the steel point is showing the location of the trouble. The more experience one has in listening to knocks the more expert will one become in finding them and telling what is loose. Each faulty motor part has a different knock which comes always in regular periods relatively to the speed of the engine.

A loose connecting-rod produces a sharp bump or a very heavy hollow sound. To locate the faulty connecting-rod is easily done by running but one cylinder at a time, in which case two bumps are usually noticeable, due to the relief of the explosion pressure. If the rod is very loose the knocks can be located by turning the engine with the crank. This trouble is caused by a twisted rod, loose bearing, scored bearing, burnt-out bearing or side play. With a seized or burnt-out bearing the motor will groan or stick in starting.

The main-bearing knocks are readily located by running two cylinders at a time, one on each side of the crank bearing. A hard bump will be noticeable throughout the motor, produced regularly with the firing of the two cylinders. Such knocks are caused by end play in the shaft, loose-fitting bearings, or scored or a burnt-out bearing. In the latter two instances the motor will groan upon starting cold.

A loose piston pin is distinguished by a sharp metallic knock. It can be located by using the listening rod for each cylinder and speeding up the motor, then closing the throttle suddenly. By doing so a double knock will be noticeable which is very sharp and better termed a rap. The knocks are caused by a crooked or a broken pin or a tight or badly worn member.

A loose crankshaft is seldom encountered. It gives a rattling slap combined with a thud. In some cases only the thud is audible; in other cases the looseness of the bearings will allow the gears to slap and rattle.



LISTENING APPARATUS FOR LOCATING KNOCKS IN THE MOTOR

Generally this trouble is very hard to discover, due to the pressure of the valve springs. The trouble can be located by sounding gear-case and camshaft bearings with the listening apparatus. The knocks are caused by loose bearings, end play or bad fitting bearings.

A loose flywheel will produce a very heavy knock at low engine speed and appear regularly. The knock will change its nature entirely when the motor is speeded up, and the vibration of the shaft will produce a dull chattering knock. It is located by disengaging the clutch and rocking the flywheel back and forth. The trouble is caused by improper fitting, loose bolts, broken bolts or bad keys and splines.

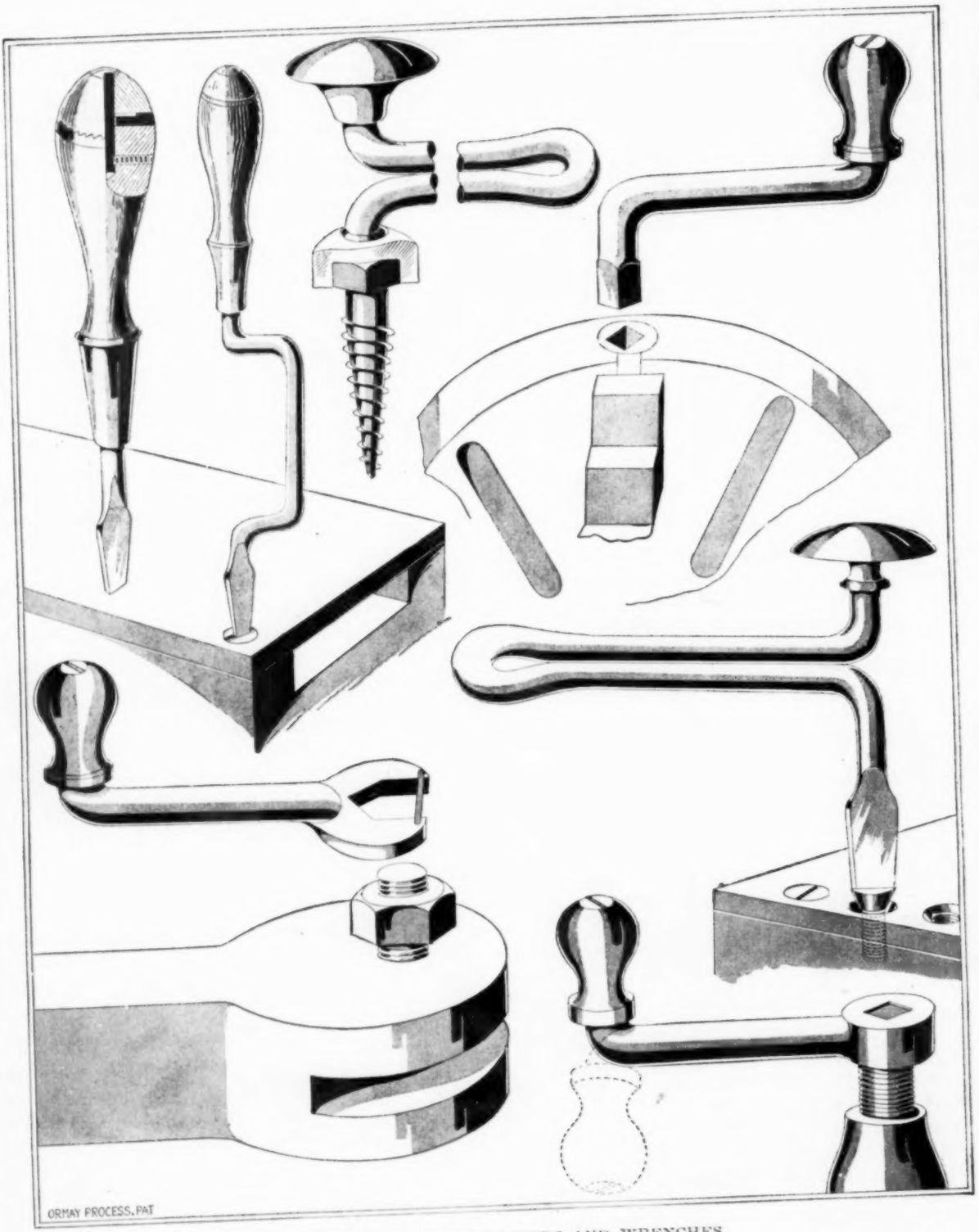
A loose piston gives a very short knock, the clearness of it varying with the size of the cylinder and metal used in the piston. It can be located very easily by the use of the listening apparatus against the cylinder wall. It is caused by a large bore, small piston, or taper piston or bore.

Loose valve tappets will produce a brisk tap or knock very often encountered and difficult to remedy on a high-speed motor. This trouble is caused by excessive clearance, bent or sticking valve stem, flat and out-of-round rollers, bent valve spring or a seat that is not square, or a combination of given causes.

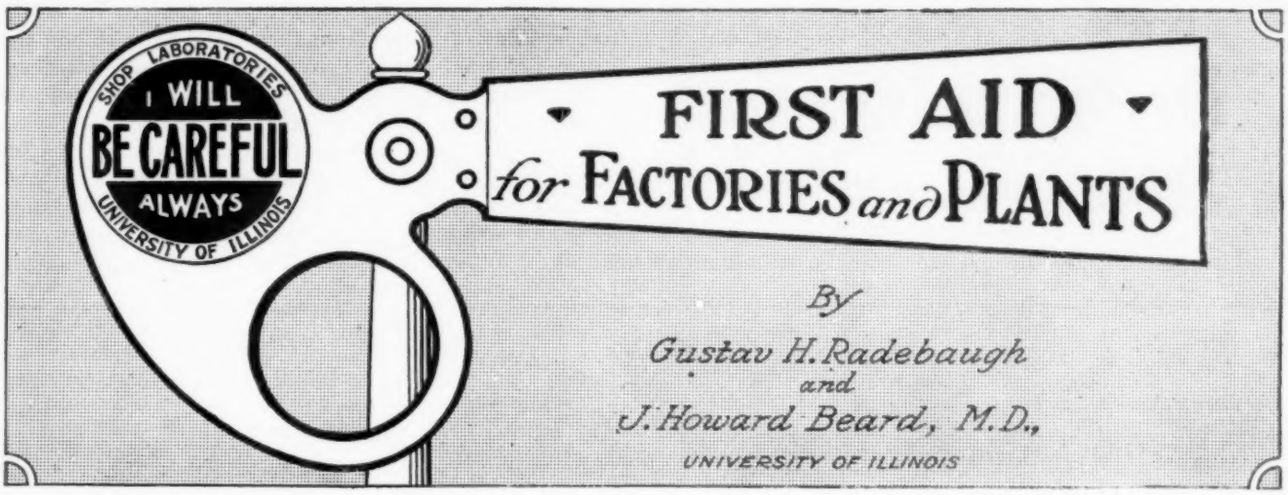
Successful hunting for these troubles requires a great deal of experience that can be obtained only by continued practice which develops the sense so that not only the different knocks are easily distinguished but are also speedily located.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



QUICK-ACTING SCREWDRIVERS AND WRENCHES



FIRST AID for FACTORIES and PLANTS

By
Gustav H. Radebaugh
and
J. Howard Beard, M.D.,
UNIVERSITY OF ILLINOIS

WITH the extensive introduction of women into the various industries and the employment of unskilled workers in occupations requiring technical knowledge we may expect an increase in the number of accidents.

As a means of promoting the efficiency of the worker and providing prompt salvage when injured intelligent first aid is most important. It saves life, gives quick relief, prevents infection and shortens the period of disability. Dr. J. D. Milligan of the Pittsburgh & Lake Erie Railroad Co. noted that in 3000 cases of men using proper first-aid methods infection was reduced to less than 1 per cent. where it had been 10 per cent. before. First aid to be valuable must be based upon the noninterference with and the protection of the wound. A first-aid man after giving treatment should get the injured immediately to the surgeon, to the trained nurse of the plant, to the hospital or to a local physician. The fate of the injured depends largely upon the man into whose hands he first comes. If the wound is treated with a simple aseptic dressing and the patient is sent to a surgeon much will be accomplished. If the first-aid man attempts to do more he is likely to be guilty of doing meddlesome surgery that may prove more dangerous to the injured than the wound.

Two million industrial accidents yearly in the United States, causing 25,000 deaths, 28,000 dismemberments, 2500 permanent, 80,000 partial and 700,000 disabilities of longer than four weeks is a casualty list more to be expected from the soldiers participating in the world war than workers engaged in peaceful pursuits. The loss of time, the decreased efficiency, the expenditure for medical care and the result of such injuries constitute a serious curtailment of the productivity of the nation and impose a heavy economic burden on the people. This burden can be lightened by the observance of the simple rules of safety outlined in this article.

The economic value of properly rendered first aid will be unquestioned if it will shorten the period of disability. A slight wound of the finger followed by infection may prevent a man from working for weeks. If the use of a simple sterile dressing will avoid infection the dressing and the time of a fellow worker in rendering first aid will represent money well spent.

A proper organization is a most important feature of successful first-aid work. Any system to be effective must have the enthusiastic support of the manager, the superintendent, the factory surgeon, the foreman and the workmen. The manager must be interested and convinced of the economic value of such an organization if his hearty coöperation is to be obtained in furnishing equipment, a place for instruction and the use of an hour or two a week of the time of the men. The superintendent must give his assistance by requiring the employees to learn first-aid methods as a part of the routine of the factory. The surgeon must give instructions by lectures and practical demonstrations and he must be judge of the efficiency of the work of the teams. The organization should promote popular interest in the conservation of life, limb, materials and machinery; it should demonstrate the economic value of first aid by the results obtained. It should instill a spirit of fellowship and coöperation in the use of safety methods, pride in the observance of factory rules for the protection of employees and the learning of proper methods for care of the injured. An effective first-aid organization should be a part of a general program of safety and conservation. A safety committee should have control of all activity pertaining to the prevention and care of accidents and to health improvement. Methods should be used that will convince the worker of the value of safety first and first aid to him personally, excite his interest in them and create a spirit of mutual understanding and help between employer and employees in the promotion of an organization for their common good. The best results will be obtained when the relations and the duties of every man are definitely outlined and thoroughly understood and each man knows and is prepared to do his part in an emergency. A diagrammatic outline of an ideal organization is shown in Fig. 1.

Stimulating interest in first aid is the function of the chief surgeon, who must have such personality and ability as will create enthusiasm in the first-aid captains and workers. The average man is very susceptible to the suggestion of his fellows.

The chief surgeon may organize the men into first-aid classes. On completion of a prescribed course and the passing of an examination each man should receive a diploma bearing the signature of the president and the surgeon of the plant. Through coöperation with the safety committee of the State Manufacturers' Association the course and diploma should be standardized and made uniform.

Many accidents will eventually reach the courts for final settlement and the question will be raised as to who gave the first aid and his qualifications. As a corporation frequently has to assume responsibility for the acts of its agents it is essential that the type of instruction and methods used should be widely recognized as correct. Unfortunately a doctor with no reputation but with a license to practice makes a more impressive witness in court than a machinist who may have shown good judgment in rendering first aid.

Plant and public interest in the importance of the prevention and care of accidents may be increased by short talks during the dinner hour in the different departments of the plant, in the neighboring Y. M. C. A., by annual field-day contests, by awarding prizes for exceptional team work and by the forming clubs to study special phases of accident prevention and care.

Schools located near plants, especially those with a manual-arts department, should give courses in safety first and first aid, for from these will come chiefly the future artisans. Such instruction will bear its fruit in the home and in the factory; it will save lives and prevent loss of time from work.

A Life and Limb Club, such as developed by the instructional staff in the mechanical-engineering department of the University of Illinois, has an appropriate name and is a particularly suitable means for the promotion of interest in safety first and first aid among students and workmen. For this reason it is worthy of detailed description.

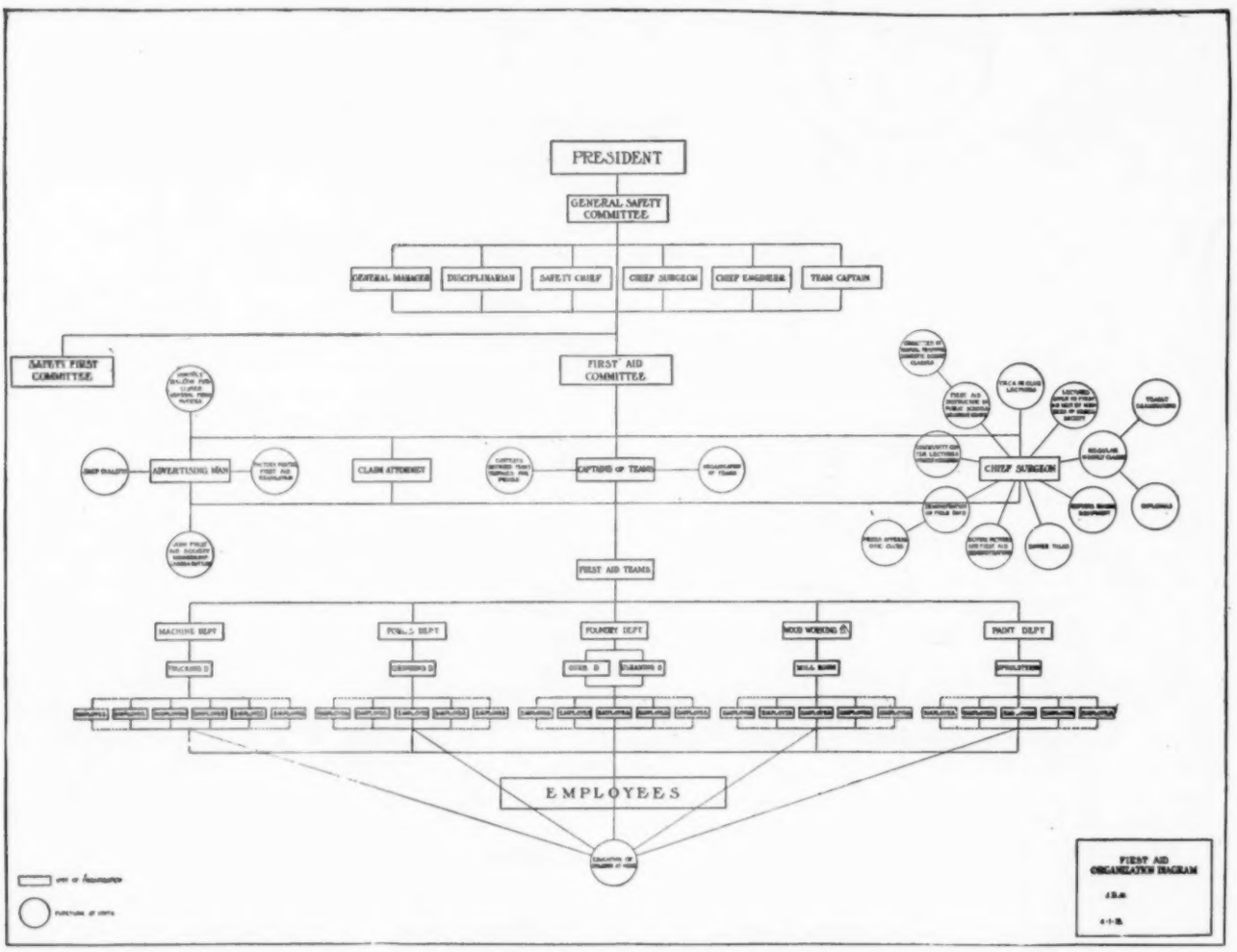


FIG. 1. RELATION, FUNCTION AND COMPOSITION OF THE VARIOUS UNITS OF A FIRST-AID AND SAFETY-FIRST ORGANIZATION

Each man on beginning work in the laboratories of the mechanical-engineering department is asked to sign a pledge, shown in Fig. 2, after which he receives the membership card and button shown in Fig. 3. The button is to be worn in a conspicuous place.

To bring the activities of the club into each department of the plant a bulletin board, Fig. 4, is located where it must be passed by the men going to and from the time clock or checking station. It is filled with club news, interesting posters and notices concerning safety first and first aid. It may also contain the names of the captains of the first-aid teams and the members of the club receiving awards or special mention for efficient first-aid work. This board should be in charge

Life and Limb Club

Mechanical Engineering Dept.
University of Illinois

Pledge

I hereby express my desire to become a member of the Life and Limb Club, which has for its objects the safety and welfare of the students while they are engaged in the use of the equipment in the shop laboratories. As a member of the club I agree to first, to obey standard shop instructions at all times secondly, make the slogan, be careful my rule of conduct, third THINK before acting to avoid injuring myself and others, and fourth, shun the habit of living the life that will dull the sense of caution

_____ 19 _____ Signature

FIG. 2. PLEDGE OF THE LIFE AND LIMB CLUB

of the advertising man, who is a member of the first-aid committee.

By-laws effectively control the election of officers, the management of the club as well as the award of the buttons.

Where the company issues a weekly or monthly bulletin interest can be further increased by giving a column exclusively to first-aid and safety-first activities, its editing to be under the charge of the surgeon and safety chief.

A system for increasing interest by the award of a button may be worked out in detail by the first-aid committee. For example, a workman may be given a button on the completion of certain standardized work, for the passing of an examination leading to the promotion to captain of a first-aid team or for special skill in rendering first aid.

Medals should be given only for exceptional service in the saving of life, limb, materials or machinery. They should be of bronze, silver and gold and to be presented annually by the president of the State Manufacturers' Association. The medal should be awarded by a committee of the association after investigation of the suitability of the candidate as recommended by the superintendent or the chief surgeon of the plant.

First-aid methods should be of such uniformity as will make them practical in peace or in war, and should be recognized by the courts as proper to be given by a layman in the shop or in the home. Their basis should be a few easily understood principles and simple dressings. Every shop employee should be required to obtain a certificate of proficiency in first aid as a means of protecting himself and his associates, to reduce the cost of casualty insurance, to increase the efficiency of the worker and to be prepared to give relief to those injured in war or in peace.

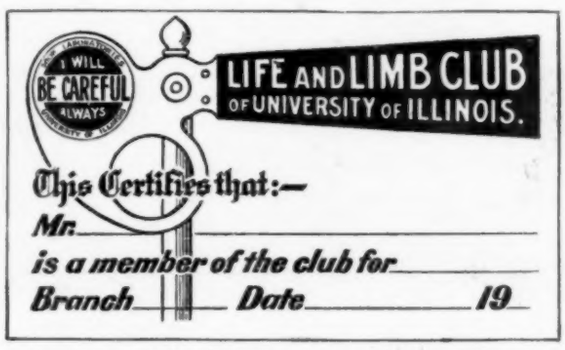


FIG. 3. MEMBERSHIP CARD AND BUTTON

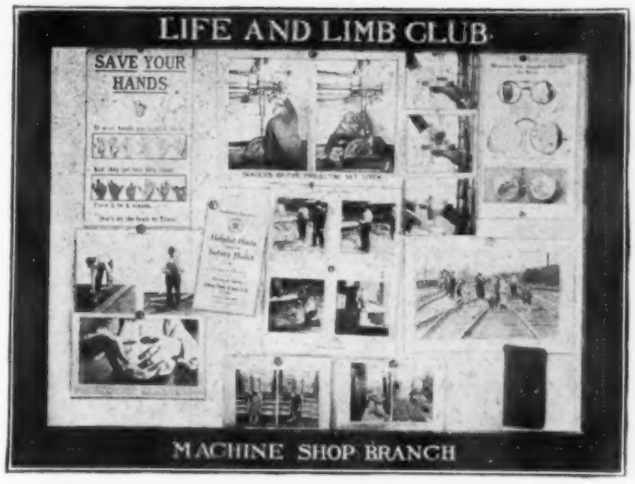


FIG. 4. EXHIBITS ON THE BULLETIN BOARD

The considerations to be emphasized in instruction may be summarized as follows: (1) To apply properly sterile gauze to a wound without contamination of either the gauze or the wound by fingers or unclean objects; (2) to paint iodine on the skin around the wound with a sterile swab or pour alcohol over it and dress it aseptically; (3) to check hemorrhage with a tourniquet only when the blood is spurting from the wound and to stop the spurting without injury to the part; (4) to place the patient on his back in a comfortable position with his head low; if cold to get him warm; if in the hot

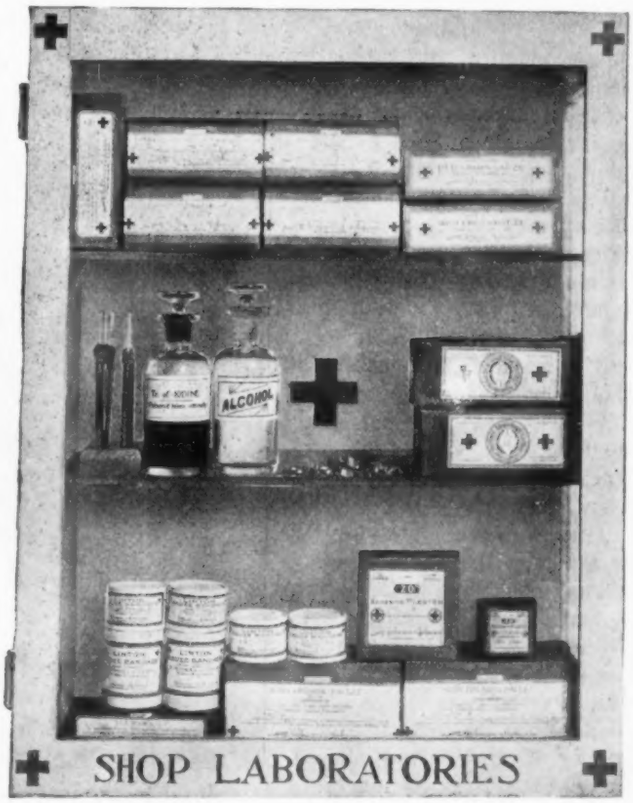


FIG. 5. A FIRST-AID CABINET

FIRST AID CASE RECORD

CASE NO. 4

FORM NO. _____ LOCATION NO. Machine Shop

DATE INSTALLED Aug. 16, 1918 CAPT. IN CHARGE S. Isobe

THIS CASE SHOULD CONTAIN THE FOLLOWING SUPPLIES		WHEN NEW SUPPLIES ARE ISSUED TO THIS CASE MAKE CHARGES BELOW					
STANDARD LIST		RESTOCKING LIST					
Amt	ARTICLE	Date	ARTICLE	Amt	Date	ARTICLE	Amt
4 Boxes	Sterile Gauze						
6	Gauze roller Bandages (two 2½ and four 1 inch)						
2	Triangular Bandages						
4	Gauze Compresses						
2 Pkgs	Adhesive Plaster (one 1" and one ½ wide)						
1	One Pair of Forceps						
1	One Pair of Scissors						
3 oz.	Tincture of Iodine						
4 "	70% Ethyl Alcohol						
6	Sterile Swabs in Test Tubes for appl. Iodine						
1	Tourniquet						
2 Pkgs	Picric Acid Gauze for Burns						
2	Tubes of Carbolated Vaseline (1% Phenol)						
2	Splints						

FIG. 6. STANDARD 5 x 7-IN. RECORD CARD

sun to put him in the shade; (5) to learn the Schafer method of artificial respiration and to use it immediately in case of drowning, electrical shock and suffocation; (6) to fix a broken arm by a sling and by resting it on the chest; to immobilize a fracture of the leg by a pillow and splint or by a blanket and splint; (7) to send workers with injuries of the eye, ear and nose directly to a physician or specialist for treatment; (8) to get a doctor quickly to the injured, and when this is impractical to transport him without further injury to a doctor or to a hospital; (9) not to give the patient whiskey or anything else, but to make him comfortable and then let him alone; (10) to learn to do nothing rather than too much.

First-Aid Equipment

First-aid equipment should be readily accessible, suitable, economical and standardized. No article of questionable value or likely to prove unsafe in the hands of the trained worker of average intelligence should be included. In each department there should be a first-aid cabinet located in a well-lighted, clean place. The type of case shown in Fig. 5 may be made in the woodworking department of any plant. This one is 17 in. wide, 22 in. high and 8 in. deep. All cabinets should be under the control of the chief surgeon and should be inspected and restocked at least twice a week. They should be tightly closed but not locked. They may be so sealed with a thin wooden pin as to be quickly opened but to leave a record of their use. When the representative of the office of the chief surgeon restocks the case charges are made upon the card shown in Fig. 6. In this way abuses are checked and economy insured.

Each cabinet should contain the following materials: Four boxes of sterile gauze, six gauze roller bandages (two 2½ in. and four 1 in. wide), two triangular bandages, four gauze compresses, two packages of adhesive plaster (one 1 in. and one ½ in. wide), one pair of forceps, one pair of scissors, 3 oz. of tincture of iodine, 4 oz. 70 per cent. ethyl alcohol, six sterile swabs in test tubes for applying iodine, one tourniquet, two packages of picric-acid gauze for burns, two tubes of carbolated vaseline (1 per cent. phenol) and two splints.

Using the Tourniquets

Such articles as tourniquets, splints and iodine may be objected to as being neither simple nor devoid of danger, but trained workers of average intelligence who are not permitted to render first aid until they have received a certificate should be able to use these articles without risk to the life or limb of the patient. In shops where accidents are likely to cause severe bleeding it would seem better to provide a proper tourniquet and instruct the men thoroughly in its application than to have them use a piece of wire or twine in a severe hemorrhage in one of their fellow workmen. If they understand the danger of the tourniquet, how it should be applied and the necessity of immediately calling a physician this objection will be largely removed. The same may be said of splints which when applied too tightly do serious harm. The splints may be so padded as to avoid a great deal of danger from pressure. The bottle containing the iodine should have a red label upon which is inscribed, "Poison if taken internally." When applying iodine a sterile swab should be removed from the test tube and a small amount of iodine poured into the tube and a part of its contents applied to the skin with the swab.

Each shop should have a first-aid station where the patient may lie down and be made comfortable until the doctor arrives. The extent of supplies of the station will depend upon the size of the shop, its proximity to

FIG. 7. FIRST-AID STATION OF THE UNIVERSITY OF ILLINOIS NEAR THE POWER AND MACHINE PLANTS

a hospital and the nearness of a surgeon. It should at least have a stretcher and a pair of blankets.

In large cities a hospital is usually located in factory districts and arrangement for the care of injured employees may be made with the hospital authorities. In such instances first aid may be given and the injured sent to the hospital. This arrangement possesses the advantage that the patient has all the resources of the hospital at his service; an anesthetic may be given with greater safety; he may be promptly put to bed after

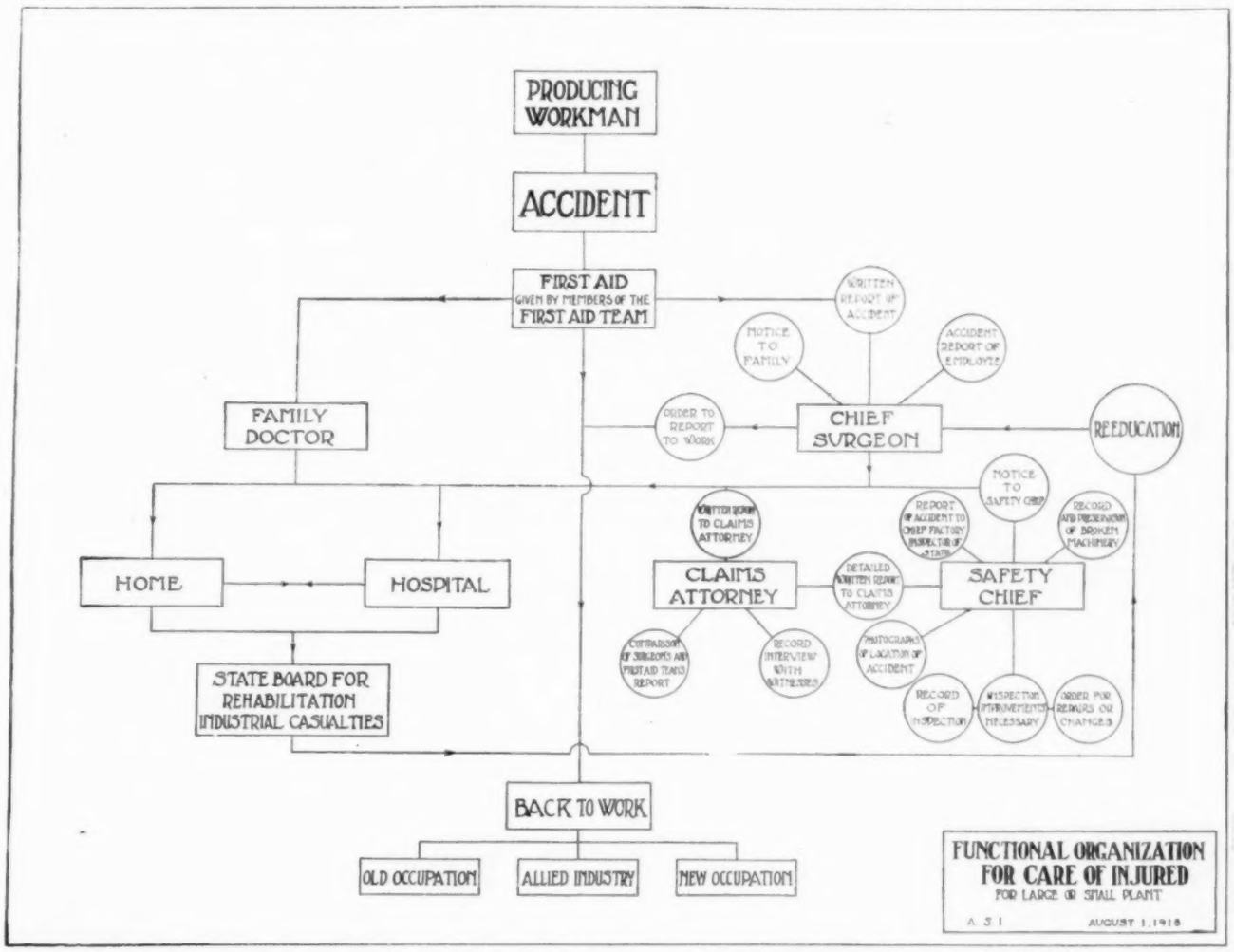


FIG. 8. FUNCTIONAL ORGANIZATION FOR THE CARE OF THE INJURED

an operation, and he is away from the noise of the factory. Minor injuries may be treated at the hospital dispensary. As a cardinal principle of this system neither the best interests of the workman nor those of the employer are served by his remaining unnecessarily in the hospital.

If the hospital is distant and a large number of workmen are employed a thoroughly equipped first-aid station, Fig. 7, should be readily accessible in the plant. It should be supplied with hot and cold sterile water, instrument sterilizer, operating table, facilities for anesthesia and general surgical dressings. As it is to take the place of a hospital dispensary it should be in charge of a graduate nurse. Shops having a station of this kind should also have an arrangement with a surgeon to respond promptly on call and who would see that its efficiency was maintained. To establish and maintain such a station would be less expensive and more practical than to permit the employee to waste time by a trip to a local physician for every injury.

The functional organization for the care of the injured outlined in Fig. 8 provides for slight injuries requiring only the application of a simple sterile dressing for those demanding hospital care, and for the rehabilitation of workers injured in their daily occupation so that they may not become objects of charity and an economic burden. It will meet the needs of the small shop, the factory and the great industrial plant with its own hospital and medical staff.

Graphic methods, Figs. 9 and 10, are striking in their presentation of facts and may be used to show monthly and annually the number of accidents, the total hours lost, the percentage of men injured, the cost of accidents to the plant and the amount of compensation awarded. Such charts should be posted in the office of the manager and the surgeon of the plant and also displayed for the benefit of the workmen. An analysis of the causes of accidents is of great social and economic importance. The records should reveal the cause, the nature of injury, the degree of physical impairment, the hazards of particular occupational groups, the exact place to apply preventive measures, the avoidability of

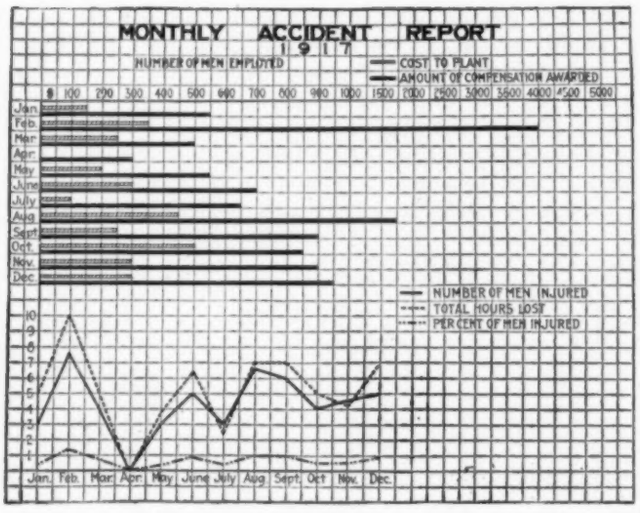

MONTHLY ACCIDENT REPORT
1917
NUMBER OF MEN EMPLOYED
COST TO PLANT
AMOUNT OF COMPENSATION AWARDED
NUMBER OF MEN INJURED
TOTAL HOURS LOST
PER CENT OF MEN INJURED
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 9. CHART SHOWING MONTHLY RECORD OF ACCIDENTS

the accident, the responsibility of the worker in its occurrence and the cost. The final report of all accidents should be made on the standard form approved by the Bureau of Labor Statistics.

When industrial accidents are thoroughly considered in their relation to loss in materials, machinery and man

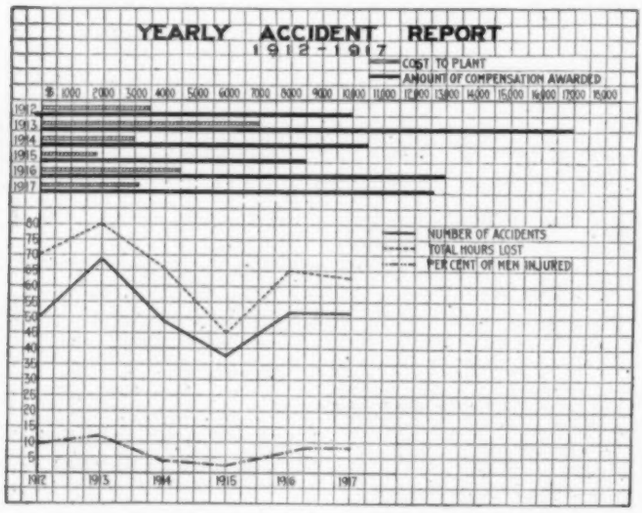


FIG. 10. CHART SHOWING YEARLY RECORD OF ACCIDENTS

power the prevention and prompt treatment of all injuries are amply demonstrated as of great economic and patriotic importance.

"How One Fellow Quit His Job"

By J. D. Cox

President Cleveland Twist Drill Co., Cleveland, Ohio

It was an August day in 1874. Our roll-turning shop was right on the east bank of the river where the afternoon sun, together with its reflection from the oily surface of the water, poured in on us unmercifully. I was working on a set of three high-rail rolls badly needed for the new 90-lb. rails for the Pennsylvania RR. The bottom roll that I had just finished was in the "stands" of the lathe, the middle roll above it in running position to verify and check the dimensions of the finished rail. At the next lathe to mine the boss was loafing along scraping dust off the neck of a pinion for the 18-in. mill that he had finished an hour before.

To change my lathe, remove the two rolls, put the top roll in the "stands" and replace the middle roll over it, was "some job," as the rolls weighed on an average of 3 tons apiece. We had no crane and had to pry the rolls up with heavy planks, block them up and roll them out on the floor and then reverse the operation to get the other ones in.

After about an hour's work, with the help of two laborers, I finished the job, very hot and tired, and my overalls wet with sweat.

I'll Quit First

Just as I stepped down in the lathe pit to adjust my toolrest the boss, a thin little Welshman with a long, red beard, crawled leisurely up on the floor, turned, spit into the pit and said, "Cox, change my lathe, I have to go up town." I knew perfectly well he had been loafing on his job for hours just to spring this on me, and if I was hot before I was hotter now. I swung around, facing him madder than a hatter, and ripped out, "No! I'll be damned if I do! I'll quit first!" Shrugging his shoulders, and in a very mild voice, he replied, "Just as you like," and walked off.

A few minutes later I saw him crossing the railroad bridge bound for a saloon where the mill men had a "hang out," so I put on my coat and went home. Well, I got to thinking the thing over that evening and made up my mind that I was very foolish to allow such a fit of passion to interfere with my plan of mastering the rolling-mill business. So the next morning I went down to see the general manager. I found him out in the mill, and stepping up to him said: "Mr. Ingersoll, I made a fool of myself yesterday and quit my job. If you will permit me to I should be glad to go back to work." "Well, well," he said, "what was the matter?" Whereupon I told him my little story.

The Manager Makes It Right

As I finished my tale I saw a merry twinkle creep in his eye and just the slightest suspicion of a smile playing round the corners of his mouth. He put his hand on my shoulder and said: "Come down in the morning, my boy, ready to go to work, but come to my office first, and I'll see what we can do with you." Well, I was there in his office when he got there. "Where are your tools?" he asked. "Over in the lathe room," I said; "I left them there when I quit." "Go get 'em and come back," he said. So off I went after my little kit of tools.

When I got back to his office he was sitting in his buggy—no autos in those days—and said to me, "Jump in!" and I jumped. We drove about a half mile up the river to the old River Side mill the company had just leased. It had been idle some time and the rolls were in bad condition. He took me into the lathe room and asked me to see if the lathe was all right. I put my hand on the driving cone and turned it over; it ran nice and smooth, so I said, "I think she'll do." "Cox, we are going to start up this mill just as quick as we can, and I want you first to dress up a set of rolls for 8 rounds P. D. Q.," said he, and turned on his heels and off he went.

The Rights to Patents and Inventions

By CHESLA C. SHERLOCK

The proprietorship of patents and the right to inventions and processes developed while the inventor is in the employ of another has been the cause of much controversy not only when the employee was under no special agreement to relinquish any claim that he might have to ideas worked out during his period of employment but also also when such specific contract has been made to that effect. This article quotes some notable decisions in respect to such rights, and in general throws considerable light upon the subject.

ONE of the causes of litigation between employers and employees is that of who has the right to the skill, time or inventive genius of the employee, and this litigation is by no means forestalled by an agreement setting out in minute detail the rights of the parties agreed upon at the time the contract was entered into.

The desire to obtain the fruits of an invention or of a patent is the prime consideration back of this litigation, and it is because the federal Government has always recognized the inventor's claim and his right to protection in the result of his genius that such litigation is encouraged and permitted to occupy the time of the courts.

No doubt this practice of the Government has been instrumental in encouraging inventors to do their utmost in their chosen fields. On the other hand the service that manufacturers, shopmen, mill men and others have performed in hiring persons of inventive skill and setting them to work along their special lines cannot be overlooked. Often important discoveries have been made by persons so employed, and they might never have succeeded in their inventions had they not had the financial aid thus furnished.

The Right to Use a Patent

In a consideration of the law on this subject a distinction should be borne in mind between the right of the employer to the use of the patent or the process and his right of ownership of that patent or process. They may sometimes appear to be the same, but in the legal sense there is a great difference.

Ordinarily one may not have a right to the use of a thing unless one has a proprietary interest in it. The courts are almost agreed that an employer has a "shop right" to the inventions of an employee regardless of whether the title to the patent is in the name of the employer, the employee or is subsequently assigned to a third person. This shop right seems to be absolute. It is not necessary for the employer to have a grant or an assignment. He may use it without consulting the inventor, and the latter has no legal way to prevent such use regardless of whether or not he holds title in the patent.

It is not my purpose to consider the question of "shop right," but to consider the right of the employer to the title and ownership of patents taken out by men in his employ on inventions and processes perfected during the course of the employment.

While the contract of employment may have much to do with the rights of the parties it is a rule that, whether the contract is a general one for employment or for the specific purpose of perfecting inventions, the employer has no right to the title in the patents allowed on such inventions unless there was an express agreement to assign such title to him. It has even been held that such an express agreement given verbally was not sufficient, the employer being unable to secure specific performance of an agreement which he could not absolutely prove.

It is also a rule that even though the employee were hired for the purpose of making inventions and paid a large salary he does not obligate himself to give his employer the title to patents issued unless such agreement was made at the time he entered the employment.

A Court Decision

In an Illinois case a mechanic working for his employer in the construction of a machine invented a valuable improvement. It was held that the invention was the property of the inventor and not of the employer. Said the court: "It may be true that where the employer hires a man of supposed inventive mind to invent for the employer an improvement in a given machine, under a special contract that the employer shall own the invention when made, and under such employment such improvement is invented by the person so employed, such invention may in equity become the property of the employer. But the law inclines so strongly to the rule that the invention shall be the property of its inventor that nothing short of a clear and specific contract to that effect will vest the title to the invention in the employer to the exclusion of the inventor."

In a contract of employment the employee agreed to work in such capacity "pertaining to the manufacture of shellers and powers, and disposing of the same, as the company may consider for their best interest; . . . that he will work for the best interest of the company in every way that he can, and in whatever way such aid can be given it shall belong to the company—that is, improvements . . . that he may make or cause to be made." It was specifically held in this case that this contract of service did not give the employer the right to title in such patents and inventions as the employee had made during his service.

In a federal case an inventor was hired to make improvements in plows for the employing corporation, for which he was paid $3000 a year. He spent the corporation's time making such improvements, which he patented in his own name. In the absence of an express agreement the corporation was held not entitled to an assignment of the title to the letters patent. It was held by the court that the corporation had nothing more than a license to use the plows so improved, which, upon the dissolution of the corporation, was not assignable to a new corporation formed by the old stockholders.

It has been held by a federal court that the mere fact that an inventor was working for another, using his shop and materials, will have no effect upon the right to the title to the invention or patent in the absence of a specific agreement to the contrary.

A Case Decided by Federal Court

In another case decided by the federal courts, a workman agreed to give his skill, attention and inventive ability to the service of a carbon company in improving the process of electroplating and other processes in the manufacture of carbons. The employer claimed that it was entitled and had the right to the perpetual use in its business and for its purposes of the improvements and inventions claimed. The court, however, said that it merely had a license and that there was no plea of title where it was not shown that an express agreement was in existence to the effect that the company should have title to the inventions or to any patent the inventor might obtain for them.

It has been held again and again that employing an inventor to invent a specific machine does not in itself give the employer the right to the title to the invention or patent so produced. Employers cannot understand why they should not have the very article which they employ the inventor to produce for them. If they were to employ the man to copy a machine already in existence they would most certainly be entitled to the machine when completed. Then why are they not entitled to the original machine when they have specifically hired the man for the purpose of producing it? The reason is that the law does not look so much at the question of what the employer was to get, but rather to whether the employee is an inventor. If so, then he shall have the full protection of the law in his invention.

This rule of the law does not apply only to where the employer is a private concern. The federal courts have said that it is also applicable to the Government as an employer, and that the Government has no right to inventions or patents granted its employees in the absence of an express agreement even though it was perfected in the Government's shops during regular hours of work and out of materials furnished by the Government.

A New Jersey Case

In a New Jersey case it was held that the mere fact that a servant makes inventions while in the service and pay of the master and in the line of his employment, in the absence of an agreement to that effect, gives the master no right to the ownership of patents therefor.

In a Massachusetts case a workman agreed to work for an employer for one year at a given monthly compensation and to assign all inventions made by him while in the master's service. When the employment terminated he made certain inventions and the employer sought to obtain them. It was held that as the employment had ended the servant was no longer "in the service of the employer" and that he could not compel an assignment of the patents.

In a New York case an expert was employed by a chemical company to discover new processes for the master's benefit. The expert made several discoveries, which he patented in his own name, and the employer attempted to hold up his salary and in this way compel him to make an assignment of the process and patent to the employer. The court held that this was untenable; that the employer had a license in the use of the process, but that he had no right to the title of it or of any patent issued therefor.

In Wisconsin a company spent several years and many thousands of dollars perfecting an invention of its superintendent with the implied promise that he would assign the patent to the company as soon as it was issued. The court held that the employer had no right to title in the patent, but that it had a perpetual license in the right to manufacture the invention and to sell it free from restriction of any kind or free from any payment of royalty.

Inventing at the Expense of the Employer

Edmunds, a recognized authority, has said that a servant, if really an inventor, may often patent his invention though it be made in the employer's time, with the use of the employer's materials and at the expense of the employer.

In a Massachusetts case, where a servant makes an invention and takes out a patent while in the master's service, but attends regularly to his duties, and uses neither the material nor the means of the master in perfecting his invention or in taking out his patent, it was held there can be no question as to his exclusive right to the fruits of his invention.

There have been cases where the courts have held that where the master's time, money and material were used to perfect the invention, the property in the invention rested in the master, but these cases have really turned upon other considerations of a more technical nature.

A Question of Payment of Royalty

This subject cannot be adequately treated unless thought is given to a statement of fact where it is agreed that the title to the invention rests in the employee and where the employer is using the invention or the process in his business. The question arises, Is the workman entitled to the payment of royalty for the use of his invention? Is there an implication in the mere fact of such use that the employer will pay such a royalty?

So far as it possible to determine there has never been a case decided, in this country at least, which holds that the mere use of a patented article is an implication that a royalty will be paid to the workman owning the title in the patent.

One authority has said: "The fundamental principle determining the question whether there was an implied contract seems generally to have been whether an actual intention to pay for the use of the patent could be inferred from the circumstances. This is especially true in those cases against the Government involving the jurisdiction of the court of claims, which does not have jurisdiction in actions of tort, but only in actions upon contract, express or implied; and the Supreme Court of the United States has said that to give the court of claims jurisdiction the demand sued upon must be founded on 'a convention between the parties—a coming together of the minds,' so there is excluded those con-

tracts or obligations which the law is said to imply from a tort."

It would seem that if a patent is used with the knowledge of the patentee's rights little more should be required to warrant an inference that the user intended to make compensation, since otherwise he would be placed in the position of intentionally committing a tort (personal injury).

A Supreme Court Decision

The Supreme Court of the United States has said: "The alternative of a contract is important to be kept in mind. The officers of the Government knew of the . . . invention and were aware of its great importance, and the purpose to deliberately take the property of another without the intention that he should be compensated—in other words, to do plainfully a wrongful act—cannot be imputed to them without the most convincing proof."

In a Minnesota case it was held that a patentee whose invention is adopted and used by a corporation is not necessarily precluded from recovery of royalty upon an implied contract by reason of the facts that during the period of its use he was an officer and stockholder of the corporation.

It seems to be a general rule that an employee owning the title in a patent which was upon an invention perfected with the employer's time, money and materials is not entitled to the payment of royalty for its use, because the employer has a license in it which the owner of the patent cannot disturb.

It has been held, however, that an implied promise may arise which would entitle the patentee to the payment of a royalty.

In Massachusetts an employee made and patented an invention at his own expense, which was used by his employer, a corporation. It was held that the employee was entitled to a royalty upon an implied promise inferred from the use of the invention.

A mechanic in Indiana perfected several improvements for his employer's machinery and patented them in his own name. The work was done at his own expense and outside his line of duty. His employer directed him, with knowledge of his rights as patentee, to install them on the machinery, and the court held that there was an implied promise to pay royalty.

The Government as an Employer

Where the Government is the employer or the one using the patented article there appear to be many different decisions. One case seems to have outlined the field of the law on the subject when it was held that an implied contract by the Government to pay compensation for the use of a patent hinged upon whether its officers took private property for public use, conceding it to be private property, or claiming that it belonged to the Government.

In another case involving the Government the Supreme Court said: "If the right of the patentee was acknowledged, and without his consent an officer of the Government, acting under legislative authority, made use of the invention in the discharge of his official duties it would seem to be a clear case of the exercise of the right of eminent domain, upon which the law would imply a promise of compensation."

It is well settled that a patentee cannot assert an implied contract to make compensation where the invention is used against the protest of the patentee and without recognition that he has any rights therein, or where it is used in ignorance of his claims and rights.

A discussion of this nature cannot be considered complete without a brief consideration of the principles of law surrounding the employer's right, known as "shop right," to use the invention of a patented article perfected by the workman while in the employer's employment.

While we have seen that the employer ordinarily has no right to the ownership or title in the patent he does not have his rights entirely cut off. He may not be able to own the patent, but he may use it, and in many instances sell it. While the courts have generally recognized the employer's right to a license in the invention they have with one exception refrained from attempting to define the rights which this license confers. In the majority of the cases they have only applied the law to the case at hand and have let it go at that.

A Federal Case

In a federal case the foreman of a brass foundry had patented certain tools which he had produced at the employer's expense. Later he permitted the employer to use them in the business, but when he left the employer's employment he sought an injunction and an accounting. The court was of the opinion that his permission to the employer to use the tools amounted to a license not only for the time he was in the employment but for so long as the tools would last. Said the court: "It can hardly be possible that an employee, himself the owner of a patent, can introduce his patented device into his employer's business without his employer's consent, and without a special agreement to pay him, and afterward turn around and demand royalties or profits and damages from his employers for the use of such device, especially in a case like this, where the invention . . . had been developed and brought to a practical condition at the expense of his employer.

Regarding Color Recipes

In a Pennsylvania case it was held that a carpet manufacturer has the right to use color recipes made by an employee in the course of his employment, even if the employee obtains patents for the formulas to protect himself against the public. The mere fact that it was a custom in the business to give a color mixer exclusive right to his recipes and permit him to carry them off at his pleasure when quitting the master's service will not alter the rule.

This can be said in regard to any business where certain persons may by the nature of their employment come into secret processes and formulas with which they carry on their work. Custom, while recognized by the law so far as practicable, will not be allowed to interfere with substantial justice.

It should not be thought that the employer has a license in any and every patent which any of his employees may happen to take out. In an Indiana case it was held that where none of the employer's material or labor enters into the discovery or perfection of an invention, and nothing of the employer's is devoted to the construction of the appliances patented until after

the invention has been put into definite form and carried to completion, and a patent either issued or applied for, no license for the benefit of the master will be implied.

We have found that (1) where the invention is perfected during working hours the master has a license in its use, but no right to the title or ownership; (2) where completed entirely outside the employment and not from the employer's materials or aid that the employer has no license in it or no right to the title, and (3) the employer has a right to title only where so agreed by an express contract, preferably in writing.

Simple Device for Marking Graduations On Swiveling Heads

By J. V. Hunter
Western Editor *American Machinist*

A simple and successful device for graduating the swiveling base of the grinding head and also for graduating the end of the table for taper settings is in use in the shops of the Dauber-Kratsch Co., Oshkosh, Wis., in the manufacture of its universal grinding machines.

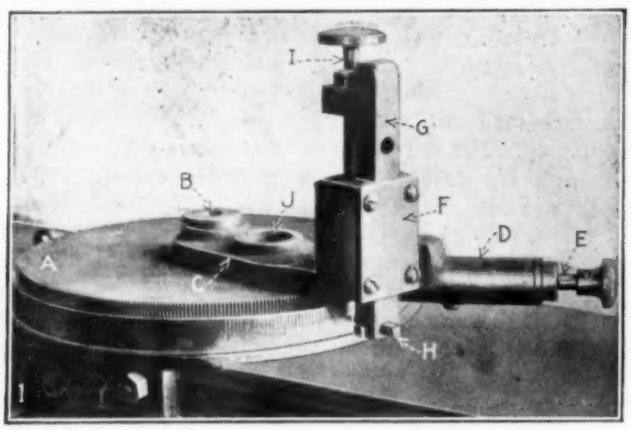


FIG. 1. GRADUATING THE SWIVELING BASE

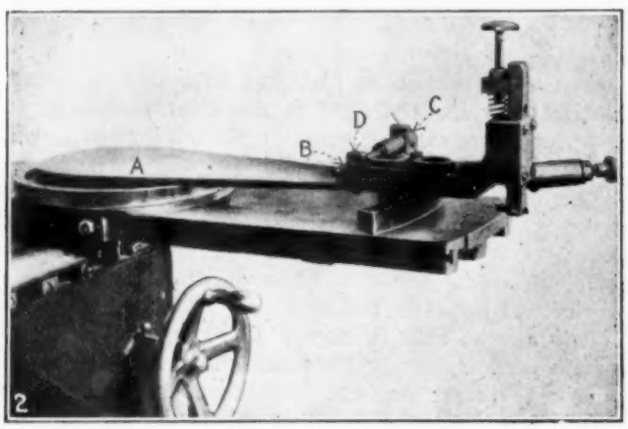


FIG. 2. MARKING THE END OF THE TABLE

Its simplicity will recommend it to those who want a small, accurate device for this purpose. The device is shown in Fig. 1.

When being used for graduating the swiveling base the plate *A*, which has 360 equally spaced notches in its periphery, is placed on the top of the part to be graduated and held in place by the pin *B*. A swinging arm *C* pivots upon the pin *B* and has at one side the lug *D*, which carries the spring-controlled rod *E* that operates the indexing plug. The marking device is carried in the square lug *F*, and consists of a sliding tool bar *G* and cutting tool *H*. The length of the graduation marks is controlled by the screw *I* and for the shorter lines by a stop that can be removed for each fifth line. A spring is used about the screw *I* to raise the cutter bar after each cut.

When graduating the smaller size of machine the arm swings about *J* as a center.

This same device with the addition of the long arm *A*, Fig. 2, is used for graduating the end of the table.

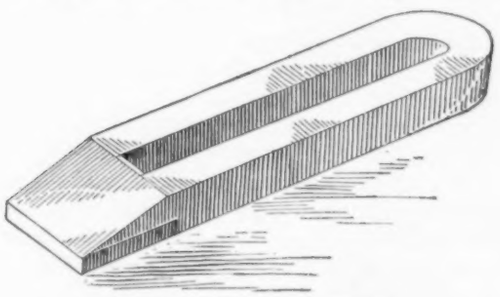
The body of the device as used in Fig. 1 is bolted to the arm and has no function except to carry the tool bar. The arm is adjusted for each successive mark by means of the screw *B*, Fig. 2, supported by the bracket *C* and operating through the swiveling bracket *D*, which is a part of the extension.

A Good Way to Make Straps

By M. L. Lowrey

Most machine shops in which I have worked have been insufficiently supplied with straps for holding work on the planing machine or boring mill, and it frequently became necessary to stop on the setup of a new job long enough to make one or more of these humble but indispensable tools. In such cases it is customary to grab any piece of iron, drill a hole in it with any drill and go ahead with the job, adding the "strap" after its first job is finished to the pile of junk that has been accumulating under the planing machine ever since heaven knows when.

The time lost in this way on a few such jobs would balance the cost of making a set of real straps that, being neatly made and adaptable to many places by reason



IMPROVED FORM OF STRAP

of the long slot, would probably be taken care of and could be found when wanted. The kind of strap to which I refer is shown in the sketch. It is by no means a new thing, but my method of making them is unusual. I take a piece of square machinery steel of suitable size, bend it in the form of a U, turn the ends together and weld them up, making a solid end as the sketch shows. On the under side of the business end of the strap I weld a piece of tool steel—a section of an old file is just about right— grind the ends and edges smooth after welding, and harden.

A set of a dozen or more of varying sizes and lengths will enable one to handle almost any job that comes along, the long slot permitting their adjustment when necessary to get them in close quarters, and the hardened end making them especially valuable when pinch clamping from opposite sides of the work.

Saving Shop Time in the Drawing Room

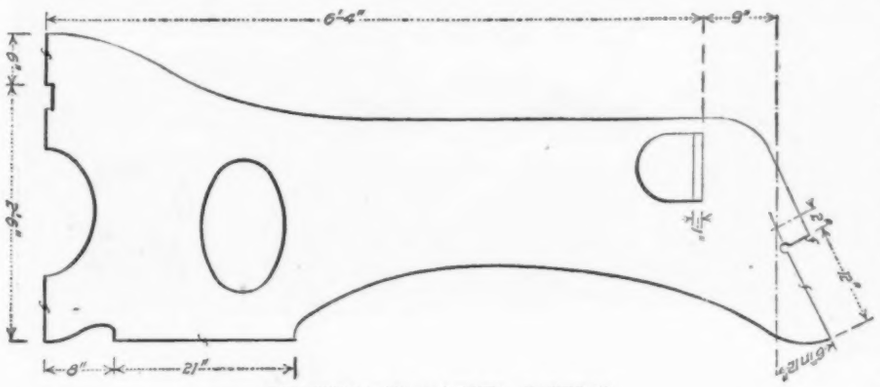
By MILES C. SMITH

The waste of shop time and the added cost of production arising from draftsmen who are inexperienced in shop work have long been noted. This treatise gives two concrete suggestions regarding the use of center lines and dimensions and the need of knowledge of the equipment in order to make practical designs.

ONE barrier to maximum production in many and employees is that of who has the right to the skill, time or inventive genius of the employee, if well conducted.

At the present time, with the machine-tool manufacturers working night and day to complete orders that are weeks and months behind schedule, we have all tried to rebuild our old machines and to equip ourselves as best we could for the new scheme of things. Naturally, this necessitated a certain amount of designing and detailing with a drawing-room force quite below the usual standard of efficiency, and though all have tried to do the best they could I am sure some important factors have been overlooked.

In the first place, in designing a tool or appliance the designer has worked on the same old principle and looked forward to the work to be accomplished with the appliance rather than the methods necessary in manufacturing the appliance itself. As a result the shop receives a set of drawings, skillfully made and well designed as far as the ultimate aim was concerned, that are often the cause of sleepless nights for the shop foreman. How were they to be made when there was left hardly a man in the shop who could decipher the intricate details and when some of the machine operations were next to impossible on the machine tools at hand? This could have all been avoided had the designer taken the shop into his confidence and so altered his design that the machine operations would have been most simple and all within the scope of the tools at hand.



DRAWING OF A STEEL CASTING

Some may say that this complaint is not general and that most reliable designers and engineers try to simplify their designs as much as they can. However, I have had to build equipment from prints gathered here and there from among the foremost engineering offices in the country, the designs of which were not very simple.

There were square holes and square keys where a drilled hole and round pin would have been not only as strong but in many cases they would have answered the purpose better. Machined surfaces not reached on an ordinary lathe, planing machine or shaping machine were called for when the same result could easily have been obtained by a small change in the casting design. Large, intricate forgings were used when the same result might be obtained by making the appliance in several pieces. In each instance the designer seemed to have taken more interest in making a handsome print than in designing an easily constructed machine.

The designer should take a walk in the shop first and acquaint himself with the men and tools at hand, so that when he puts the "*f*" mark on his drawing he may have a mental picture of the operations that are undergone. Minutes now mean dollars, and every time we accomplish a way of saving time, so much more is added to the production of wealth, and to that extent help to replenish what has been destroyed.

Another point that is being daily overlooked is that of making working drawings so that they are perfectly clear to the one who must interpret them. A shop drawing should be so clear that anyone, no matter how far from a mechanic he may be, would be able to see at a glance exactly what is wanted. Many designers persist in the old-time methods of not giving center lines and seem to believe that every machinist thinks in angles and decimals.

Give the machinist center lines through the work. If they cross, cross them at right angles, and when you give him a dimension start from a place on the work he may easily find and not from some point in space which comes handy when making up the drawing. Bear in mind the workman cannot employ drawing-room methods when laying out his work, and particularly in the case of castings there is generally something to hinder drawing lines here and there as is possible on paper.

Give over-all dimensions. Start from one end and give him the over-all so he does not have to figure before he knows whether or not he is able to get the desired results from the forging or casting. Sometimes all these rules cannot be followed while the drawing is in the making. In such cases it is necessary for the designer to fill in the necessary information after his own work has been finished, which is time well spent, because it is a very simple matter to work out points on paper which would take a great many hours to find in the shop.

The illustration, while not identical with the original, is from one of the best-known engineer's offices and

shows the difficulties referred to and will no doubt bring home many similar instances in the reader's experience. The casting is of steel, and all dimensions are given from an inaccessible point, no center lines being given to help the machinist to determine the relative proportions and no over-alls.

Let us all try to correct these time-consuming evils when possible.

Launching a Ship

By E. A. DIXIE

HAVING been asked several times what is done to start a ship on its way just previous to the breaking of the champagne bottle on the prow it seems to me the question may be of general interest.

Some time before the ship is ready to launch the ship carpenters prepare the launching ways or, in other words, the runway on which the ship slides into the water. The ways on which the ship is built have a slant of about ⅜ in. per foot of length. This angle has been found to be satisfactory, if all other conditions are as they should be, for launching vessels endwise.

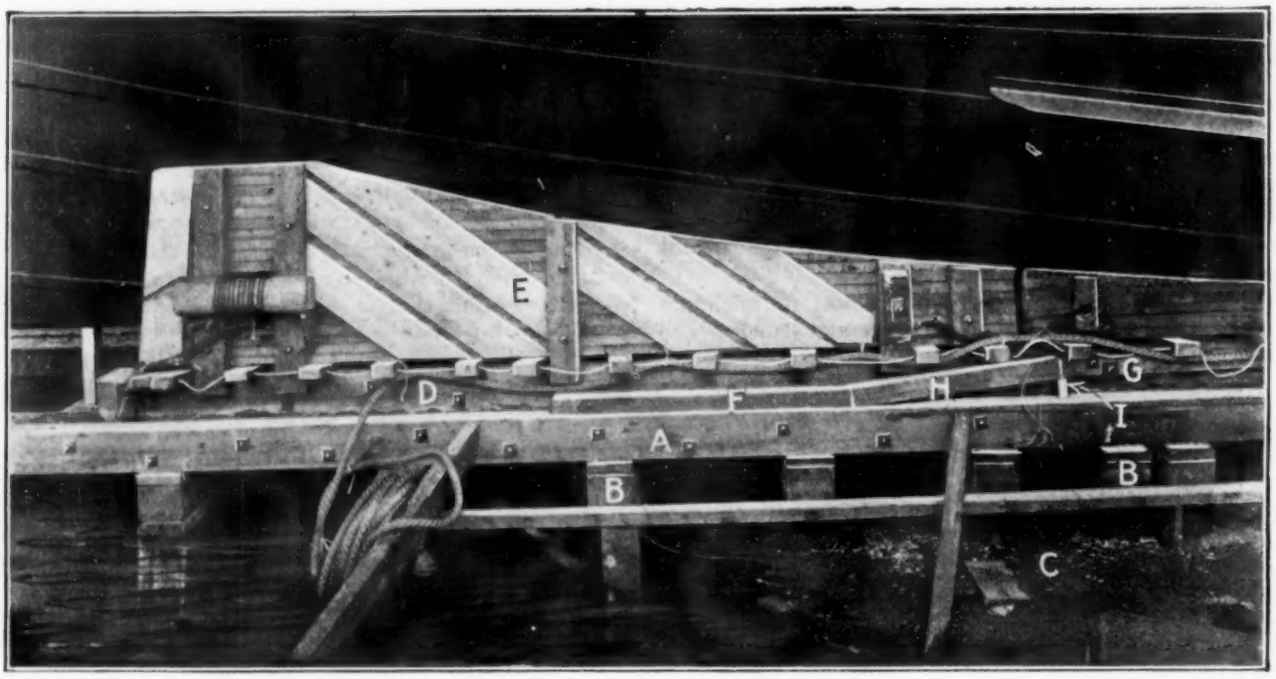


FIG. 1. STERN END OF LAUNCHING WAYS

In Figs. 1 and 2 are shown the stern and bow ends respectively of the launching ways.

The carpenter first lays down and securely fastens the timbers *A*, Figs. 1 and 2. These are laid on the cross-timbers *B*. The opposite side of the ship is also provided with timbers *A*. The two sides *A* are tied together by long bolts which prevent them from spreading and dropping the ship on the concrete ship-way floor *C*. The top of the launching way *A* is now thoroughly greased with tallow. Other greases have been used as a lubricant, but the average ship carpenter pins his faith to tallow, as on more than one occasion these substitutes for tallow have been blamed for causing vessels to stick on the launching ways.

On top of the greased timbers *A* other greased timbers *D* are placed, and on top of these the cradle is built. As its name implies the cradle is that part of the structure on which the ship rests and it reaches practically from end to end of the ship. It is fitted as closely as possible to the ship's hull, but owing to its location and to the fact that it is installed when the ship is nearly completed it is impossible to fit it so that it will take any of the weight of the ship, which of course rests on the keel blocks. The hull is also supported by shores or props, which keep it upright.

Near the stern end of the launching ways is a timber *F* on each side, see Fig. 1. This timber is securely bolted to the stationary way *A*. In a similar manner on each side of the ship a timber *G*, Fig. 1, is bolted to the top or sliding member *D* of the ways.

Tilted at an angle between the forward end of the timber *F* and the after end of the timber *G* is a short timber *H* which is held from falling at the forward end by the small block *I*.

At the forward end of the ways shown in Fig. 2 the forward end of timber *J* is securely bolted to the stationary way *A*. The after end of the same timber is securely bolted to the sliding way *D* under the cradle. A similar timber is employed on the other side of the ship.

In both illustrations a number of wooden pieces will be observed between the cradle and the sliding way *D*. These are long wedges, and a rope is strung through them so that they may be recovered from the water after the ship is launched. Similar wedges are employed on both sides of the ship. When ready for launching they are driven in, thus lifting the ship.

When the keel is clear of the keel blocks the keel blocks are removed. The entire weight of the ship is now carried by the launching ways and all that keeps her from sliding into the water are the dog shores *H* at the stern and the timbers *J* at the bow.

Just before launching the small key piece *I*, Fig. 1, is knocked out and the dog shores *H* driven down and out with a maul. This leaves the two timbers *J*, Fig. 2, one on each side of the hull near the bow, to hold the cradle and ship from sliding.

In Fig. 2, at *K*, is a hand crosscut saw. When everything is ready a signal is given and the two men on each side of the ship saw through the timbers *J*. Sometimes the timbers pull apart before the saws cut entirely through. Occasionally the ship refuses to move even after the timbers are cut through. Hydraulic jacks and other "persuaders" are used in such cases.

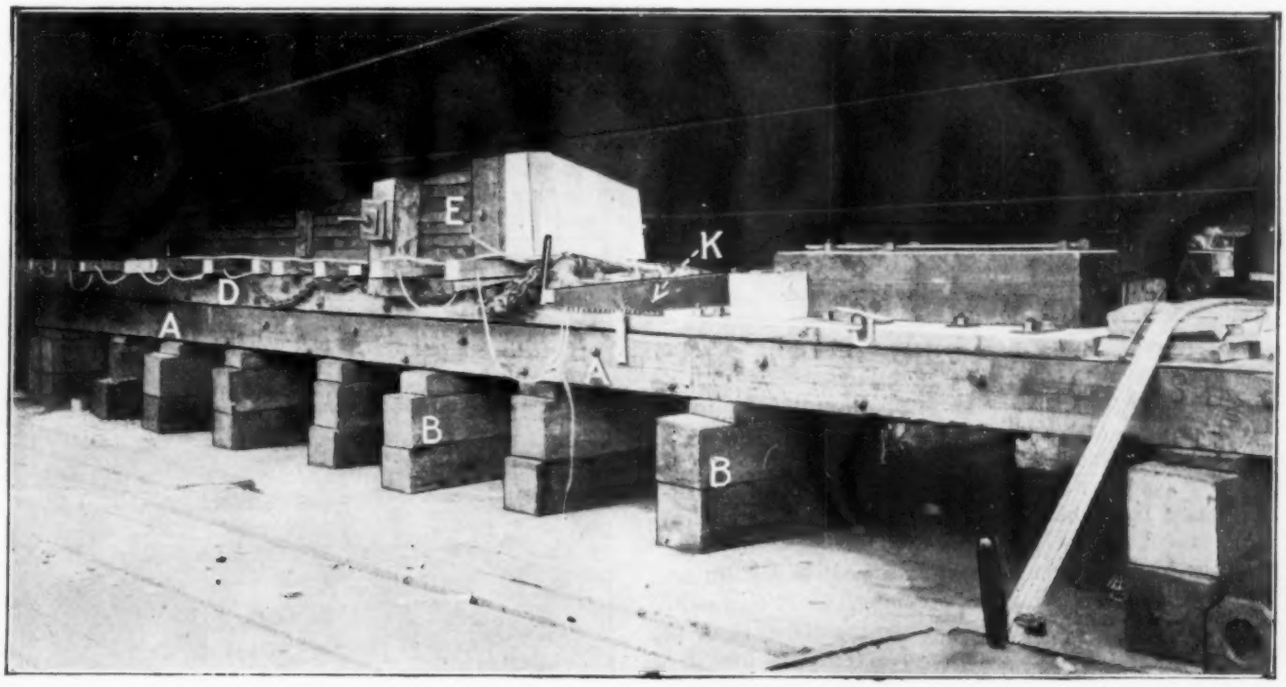


FIG. 2. BOW END OF LAUNCHING WAYS

The Modern Foreman—What Is His Present Job?

By G. CLOCHE

It appears to me that your previous correspondents have failed to appreciate the full significance of the question they ask, and to a certain extent appear to have a queer notion of the foreman and the position he is intended to fill. The point of view, if I understand it correctly, seems to be that in the old days the foreman was a very important personage indeed, brimful of mechanical genius and resource; an autocrat to be looked up to, feared or respected, according to his temperament—mostly to be feared, I should say, in the judgment of some of your correspondents. Even Entropy speaks of "superintendents and foremen carrying on an autocratic rule of the worst kind for the love of it and because they are Huns at heart."

The idea seems to be that the "modern" foreman is losing his power and his job and, under the new order of things, before long, is not going to be required. All the new scientific methods of management are about to usurp his position. This, I think, is very far indeed from the truth, and I beg to postulate the idea that never before was the foreman so important a person as he is today, and he will be increasingly so in the future. There is a new spirit abroad, a larger life looming ahead, and the modern foreman must take it into consideration and assist in the molding of it, and if he is intelligent and broad minded he will be successful.

In the first place an organization, whether it be a large or small one, is compelled today to consult the representatives of the trade unions, etc., on matters of general principles, wages, hours of labor, etc. Obviously these are matters outside the province of the foreman. Then again the nature of the product of a concern has to be determined or modified from time to time. Here the foreman is not necessarily concerned. But once the fundamental rules of the organization have been determined and the nature of the product fixed the foreman must bring his intelligence into operation in the interpretation and administration of these principles and ideas in his particular department. On the face of it this may not seem much, but it is highly important. Through the failure to interpret the idea and the spirit at the back of the rules laid down for the conduct of a shop there may arise misunderstandings leading to friction and strikes involving great monetary loss. A foreman must always remember that in giving judgment on any matter he is speaking in the firm's behalf and in a measure committing his employer

Whatever form of scientific organization be adopted it is plain that there will always have to be heads of departments, or foremen. And in the new democratic age the modern foreman will have to become less a boss and more a leader. He will have to help to promulgate the

fact that to live we must work, and while in our working arrangements we must have order and discipline, yet the worker is doing something more than "working for the boss"—he is working for himself; he is working for his fellow men; he is working so that the wheels of society will run smoothly and produce those things that go to make up many of the comforts and the happiness of life.

When there is a better understanding on these lines between employer and employed, foreman and workman, then the details of a foreman's job will take on a new aspect.

And in the incidental or detail things of a workshop, what scope is there for a good foreman?

The Foreman Must Help the Workman

If the true spirit is to be fostered that will lead to success the foreman must help the workman to feel that he is working with the foreman and not for him. This accomplished, the suggestions and hints on how to do things better and more successfully will not be looked upon as undue interference and swagger and an assumption of an "I am cleverer than you" attitude. Rather it is my belief that they will be accepted as a true foreman will give them, as a sincere effort to help.

Then think of the example a foreman may be to the apprentice boy. We all in youth, unconsciously it may be, emulate someone in certain matters, and often a foreman's actions or ways of performing certain acts are copied by an observant youth unknown to the foreman. So it is that from the highest and best of reasons the modern foreman's job is a most important one. All these things are but the stepping stones to another job of the foreman, and that is the maintenance of the efficient manufacture of the product of the firm that employs him. It is profitable production that counts.

Production a Vital Element

Profits are right and legitimate and are not necessarily the outcome of oppression and the squeezing of the last ounce out of the workman. Production is a vital element. The greater the production the greater the chances of profit, the greater the profits the greater the chances of higher wages, and the greater the amount of goods produced the better for society in general.

The modern foreman must realize that he plays a very large part in the work of production. He it is who is directly up against the work if he is doing his job as a *fore* man. He can eliminate unnecessary movements by a little thought given to motion study; he can keep an eye on the wear and tear of the multitude of details in the way of nuts, bolts, steel plates, bearings, end play in spindles of machines, eccentric motions of jigs, etc., and have them renewed or replaced at the correct moment and thereby save much scrap that would otherwise be accidentally made. All these things and many more are within the scope of the modern foreman. Indeed his position is a great one in many ways if he will rise to it, and it is hoped that he will realize his possibilities and play his part nobly in the new age.

To accomplish all the foregoing will require a nature that is large-hearted, sympathetic and firm. Hence the job of the foreman requires much skill, is an extremely interesting one and intensely human. If he is the right man in the position he will not be slighted or overlooked by the other departments of a successful firm, but will coöperate with them and fill his position cheerfully, realizing that he is a tooth in the gigantic wheel of commerce without which the machine would not do its work so well.

Ford Tractor Trucks for Use in Shops

By E. V. Allen

When shops are large and buildings are a distance apart it is necessary to have some means of transporting material not only from one shop to another but also from one part of a building to another. The officials at the Chicago shop of the Northwestern Railroad have

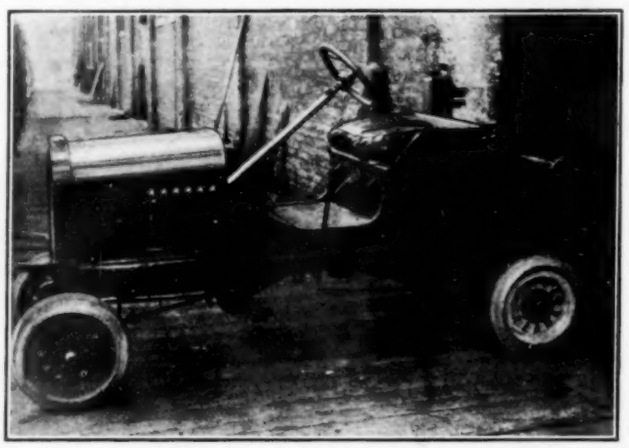


FIG. 1. THE FORD SHOP-TRACTOR TRUCK

solved the problem for their own use by fixing a Ford as shown in Fig. 1. Special built wheels are used which with the solid-rubber tires are 19 in. in diameter with 3 in. width of tread. The broad platforms and

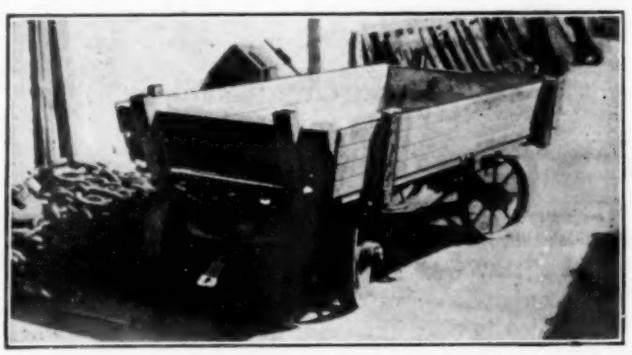
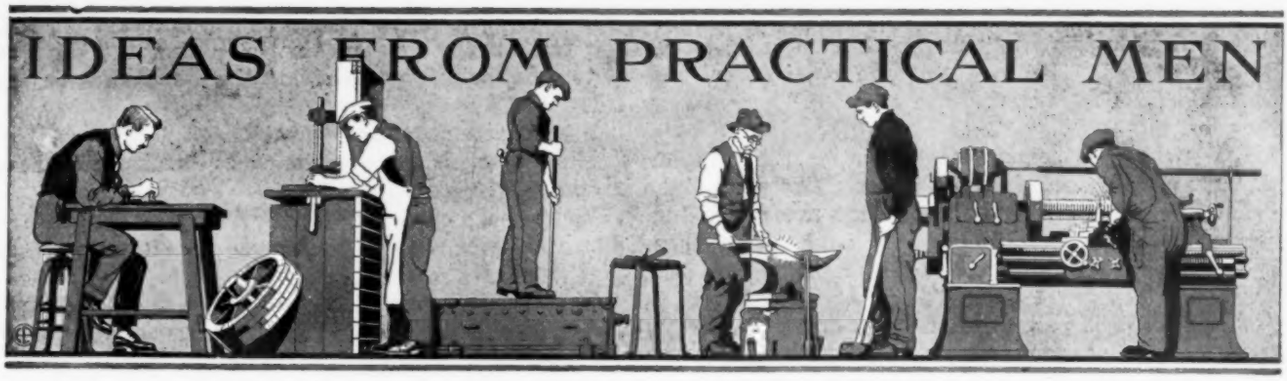


FIG. 2. ONE OF THE TRAILERS USED WITH THE SHOP TRACTOR TRUCK

shop runways of a railroad shop lend themselves well to a tractor of this kind.

One of the trailers used with this type of tractor is shown in Fig. 2. It is large and strong enough to carry the heaviest material used around the average machine shops.

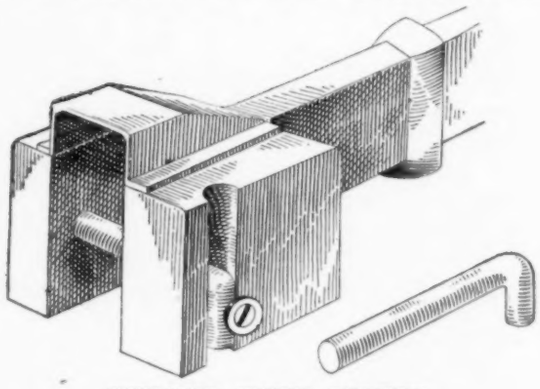


Improvement in Wheel Dressers

By Martin H. Ball

Having experienced trouble from the turning of the pin in the ordinary form of wheel dresser, with consequent wear of the holes, the design shown in the sketch has been adopted.

The end of the pin is bent at a right angle to its body, and this bent portion lies in a vertical groove at the



IMPROVED WHEEL DRESSER

side of the holder. It is held in place by a washer and small button-head screw, and thus effectively prevented from rotating with the cutter as most other kinds are likely to do.

The life of the dressers has not only been materially increased but better service is given as well.

Measuring Gears by the Use of Wires

By John W. Lee

I desire to make a slight criticism on the article "Measuring Gears by the Use of Wires," published on page 291, Vol. 49, of the *American Machinist*. The first part of the article states that the diameter of the pins is such that they touch the teeth on the pitch circle, which is correct; but further on it says, "Let us then make our pin diameter such that the center line of the pin lies on the pitch circle."

It is not possible to have the center of the pin on the pitch circle and still have the pins touch the two adjacent teeth at the pitch circle, as by using such diameter pins they will always drop into the tooth space so far that they are below the outside diameter of the gear and are very hard to measure over. These pins will touch the teeth somewhere between the pitch circle and the base circle, and thus we would not measure the pitch diameter, but an imaginary diameter somewhere between the pitch and base circles.

The pitch diameter is what all gear calculations are based upon, therefore the pitch diameter is what should be measured, and to measure it by this method the pin

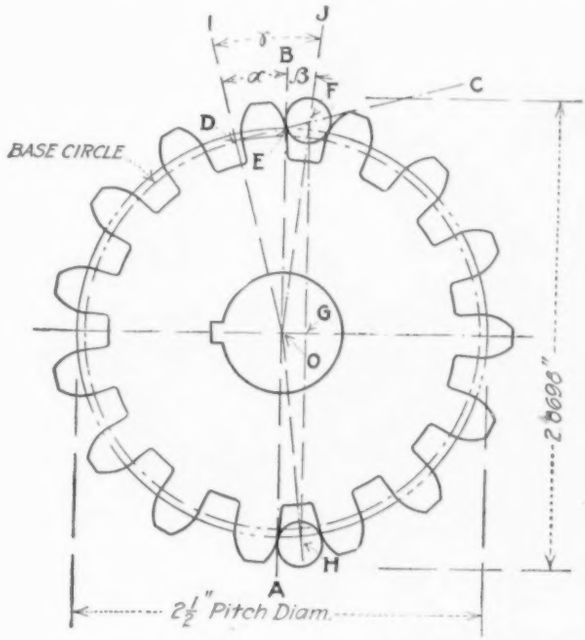


FIG. 1. EXAMPLE OF GEAR TO BE MEASURED

diameter must permit the pins to touch two adjacent teeth at the pitch circle.

To figure the diameter of such pins and the dimension indicated by them is a very simple matter and can be accomplished as easily and accurately in the case of gears as with screw and worm threads, in connection with which the method is widely used.

The procedure is exactly the same in each case, except that for threads it is necessary to use three pins, while for gears only two are required, or the measurement can be taken with one pin in connection with a plug in the center of the gear.

The diameter of the pin must be such that when it is placed in the tooth space it will touch two adjacent teeth at the pitch circle, and it will then always project above the tops of the teeth where the micrometer or vernier can be easily applied.

When the number of teeth in the gear to be measured is even, there are two right-angle triangles to be solved, and when the number of teeth is odd there are three.

Referring to Fig. 1, which represents a 15-tooth, 6-pitch, 14½-deg. involute gear, the two circles, the centers of which are at *F* and *H* respectively, represent the pins.

Let *AB* be the center line drawn in such position that it will intersect the tooth curve at the pitch line.

Let the straight line *CD* represent the unwinding string that generates the involute tooth curve, then *D* is the point of tangency of the string to the base circle.

The line *OI* is perpendicular to *CD*, and *CD* being the pressure line the angle α is equal to the pressure

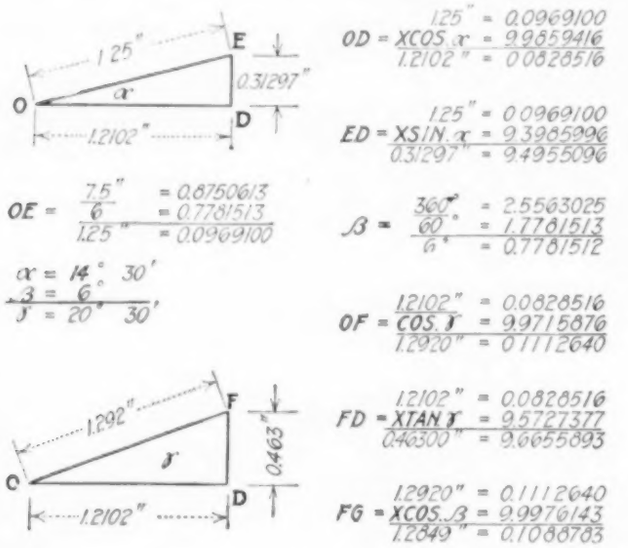


FIG. 2. SOLUTION OF FIG. 1

angle; the radius of the base circle is equal to the radius of the pitch circle times the cosine of the pressure angle α, and the radius of the tooth curve at the pitch circle is equal to the pitch radius times the sine of the same angle. *E* is the point where the center line *AB*, the straight line *CD*, the pitch circle and the tooth curve all intersect, and is also the point of contact between the pin and the tooth of the gear.

The center of the pin must be on the center line *OJ* of the tooth space and must also be on the straight line *CD* to be tangent to the tooth curve at the pitch circle.

Therefore the center of the pin must be at the intersection *F* of the two straight lines *OJ* and *CD*, and the distance from *E* to *F* is equal to one-half the diameter of the correct size of pin to be used.

It is readily seen that the distance *E* to *F* is equal to the difference between the sides opposite of the two right-angle triangles *DOE* and *DOF*.

The angle β is always equal to 360 deg. divided by four times the number of teeth in the gear to be measured.

The angle γ is equal to the sum of the two angles α and β. The distance *D* to *E* is found by multiplying the pitch radius by the sine of α, and the distance *D* to *F* is found by multiplying the base radius by the tangent γ.

The diameter of the pin equals 2 *EF*.

The distance *O* to *F* is found by dividing the base radius by the cosine of γ.

When the number of teeth in the gear is even the dimension over the two pins equals the diameter of the pins plus 2 *OF*.

When the number of teeth in the gear is odd there is still another distance to be figured, which is *FG*.

It is readily seen that the line *FH* is parallel to the center line *AB*, therefore the angle at *F* in the right-angle triangle *OFG* is equal to β, and the distance *F* to *G* is found by multiplying the distance *O* to *F* by the cosine of β and the dimension over the two pins is equal to the diameter of the pins plus 2 *FG*.

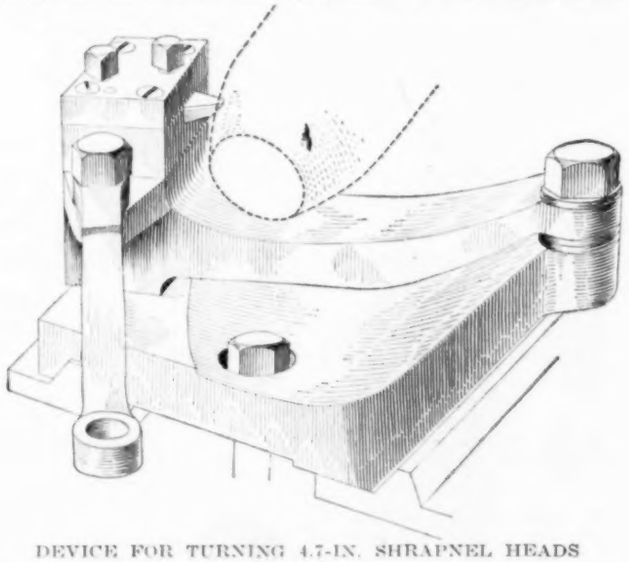
For example, let us take the 15-tooth, 6-pitch, 14½-deg. involute gear shown in Fig. 1. We first find the pitch radius *OE* by dividing one-half the number of teeth by the diametral pitch.

To shorten the calculations we will use logarithms, the operations then standing as in Fig. 2.

Device for Turning the Radius on 4.7-In. Shrapnel Heads

BY R. S. MYERS

Having experienced some trouble in getting the radius on 4.7-in. shrapnel heads with a wide form tool the following described and illustrated attachment was devised for use in a 14-in. engine lathe in machining them.



DEVICE FOR TURNING 4.7-IN. SHRAPNEL HEADS

A nosepiece having a threaded collar was fitted to the lathe spindle to hold the shrapnel head. This head was screwed into the collar and the collar screwed on the spindle nose until the head came in contact with the end of the spindle.

As shown in the drawing the auxiliary table is bolted to the lathe bed in front of the carriage at the proper distance and the movement is transmitted to a cutting tool held in the movable arm by a connecting link attached to the toolpost.

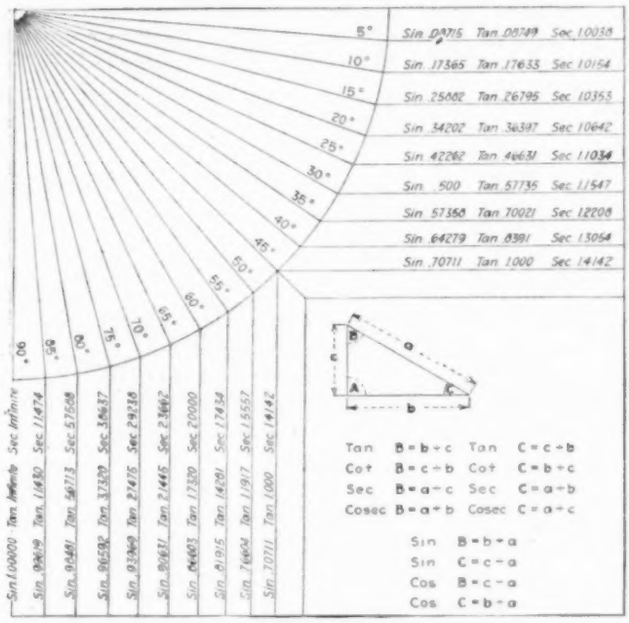
With this arrangement only one cut is necessary, and once the tool is set every piece comes the same.

A Chart of Angles

By Harry Hodgkinson

Some time ago one of our foremen asked me to get up a chart of angles that would present desired information in a form easy to find and thus making it unnecessary to dig it out of a book.

After several efforts I evolved a chart that looked as



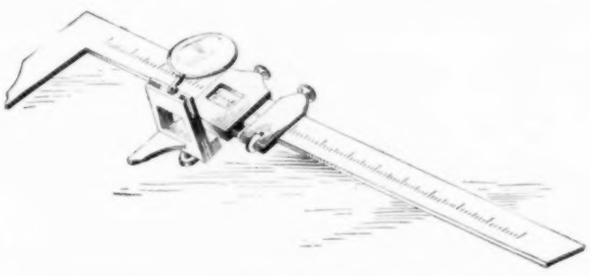
A CHART OF ANGLES

if it might be useful to whose who have to do with angles and a reproduction of which is shown herewith.

Microscope Attachment for a Vernier

By Hamlin Clay

This sketch shows a microscope attachment which I made for my vernier and which saves considerable time when the tool is constantly in use. It is made of aluminum, is very light and not in the way, and it enables



VERNIER WITH MICROSCOPE ATTACHMENT

the operator to use both hands in making a setting while directing his entire attention to the vernier reading.

The attachment is fitted over the movable jaw of the tool and fastened in place with a small knurled-head screw. Its height should be right to bring the glass in sharp focus, and for this reason the glass should first be secured and its focus determined. A glass of about 1¼ in. in diameter is most convenient.

A slot in the upper edge of the attachment is a tight sliding fit for the flat piece which forms a part of the mounting of the glass, allowing the latter to be moved back and forth to bring it central over the desired line on the vernier and thus avoid distortion.

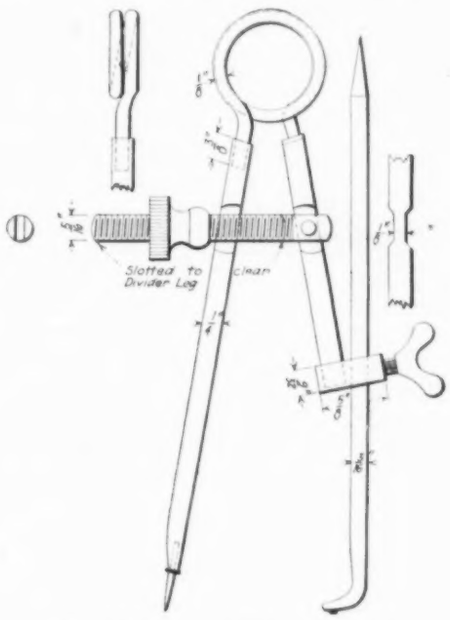
Homemade Spring Dividers

By Lieut. L. H. Morgan-Browne

Somerset, England

The cut shows a very handy small tool that I ran across some time back in a works in this country.

The $\frac{1}{8}$-in. steel-wire spring is sweated into holes drilled



HOMEMADE SPRING DIVIDERS

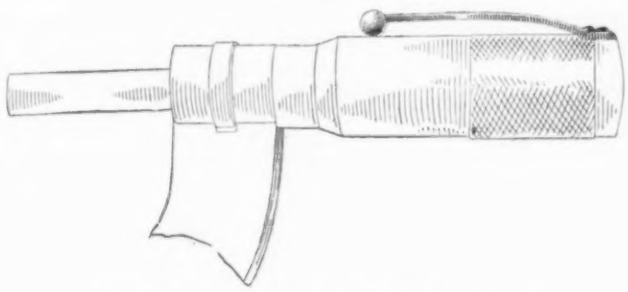
in the top end of the legs and the point of the fixed leg is a gramophone needle similarly secured to the other end.

I have had occasion to use this tool and I find it very handy.

Clip to Hold "Mike" in Vest Pocket

By J. W. Lawson

Many mechanics carry a micrometer in their vest pocket, and it often happens that when they bend over it falls out on the floor and is damaged. The mi-



CLIP TO HOLD "MIKE" IN VEST POCKET

crometer shown in the cut has an old fountain-pen clip cut off and soldered to the barrel, making the tool secure in the pocket.

The Making of a Toolholder

BY ROBERT MAWSON

The toolholder that is the subject of this article requires some interesting shop operations to produce. A brief description of the holder and some of the operations followed in its manufacture are appended.

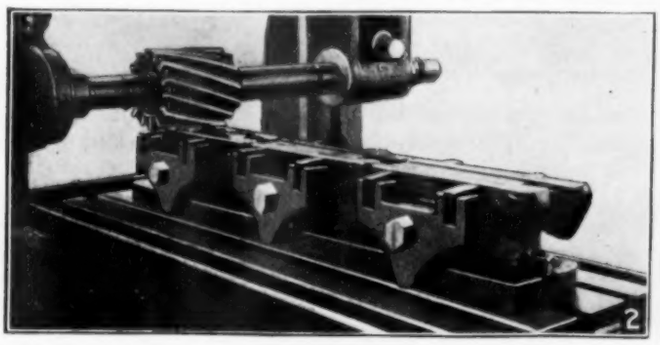
THE toolholder, samples of which are shown in Fig. 1, has a tool-steel insert under the cutting bit to take the pressure off the cut, this insert being forced into place during the process of manufacture and electrically welded to the body of the holder of which it thus becomes an integral part.

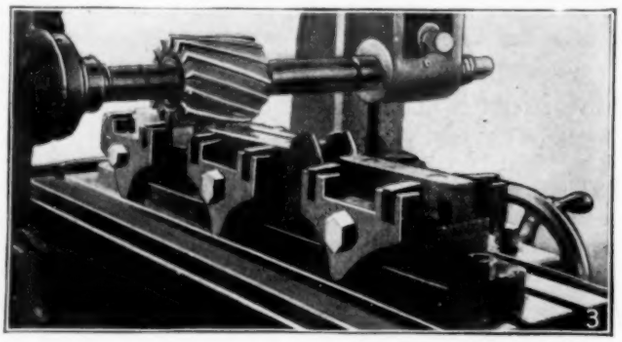
The body of the holder, which is made by the Ready Tool Co., Bridgeport, Conn., is a drop-forging of chrome-nickel steel and it is made in three styles—straight shank, and right- and left-hand offset.

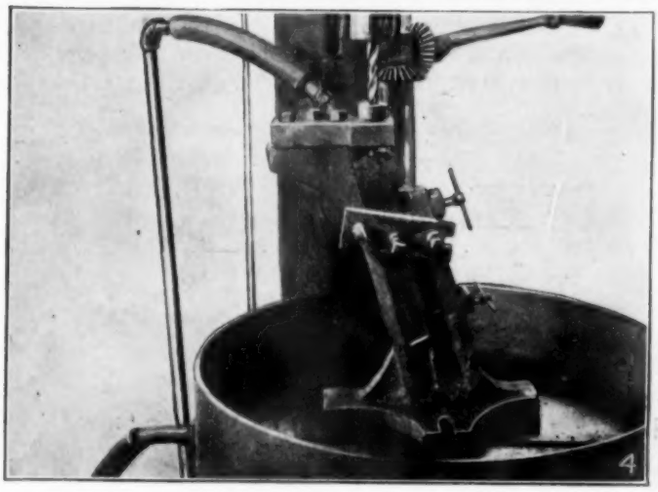
The first machine operation on the forging is the milling of the bottom surface, which provides a locating point for all subsequent operations of manufacture and also insures an even bearing for the holder when it goes into service. The fixture for holding the work for this operation is shown in Fig. 2. It is designed to hold six forgings at once, and the grip is through compensating clamps, which have a bearing at three points, two of which are on the work. Each pair of clamps is tightened by a single bolt passing clear through the fixture.

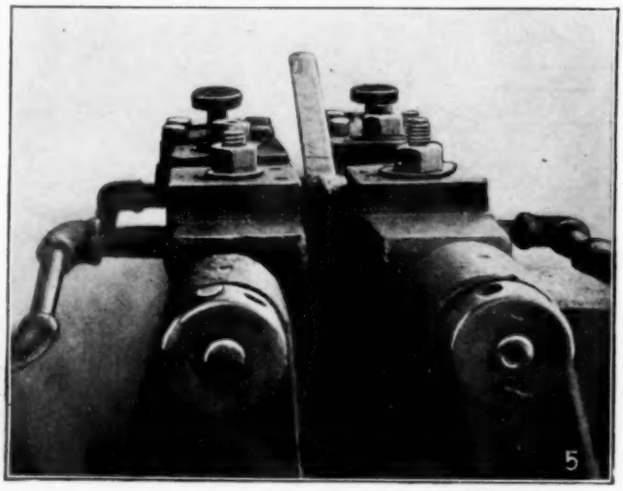
The same fixture is used, as in Fig. 3, to surface the opposite side of the forging, but in this case only two pieces can be handled at once, as it is necessary to stop the cutter before it reaches the raised portion which forms the boss for the setscrew. A plain, spiral, fluted cutter 4 in. in diameter is used for the work.

Following this operation a $\frac{27}{64}$-in. hole is drilled at an angle through the head and a piece of drill rod is forced into the hole. The drilling operation is shown in Fig. 4, and is done under a flood of cutting compound. The tool then goes to the electric-welding machine shown in Fig. 5, where the plug is fused in and becomes practically a part of the surrounding metal. The forgings then go to the heat-treating department for carbonizing. In this department the work, after being subjected for 8 hours to a temperature of 1700 deg. F., is allowed to cool slowly before being removed from the carbonizing material, the effect being to leave the pieces soft and workable. The holders are now drilled in a fixture very similar









FIGS. 1 TO 5. OPERATIONS IN MANUFACTURE OF TOOLHOLDER

Fig. 1—Three styles of toolholders. Fig. 2—Milling the bottom of the holders. Fig. 3—Milling the top surfaces. Fig. 4—First drilling operations. Fig. 5—The electric-welding machine

to that shown in Fig. 4, the same-sized hole being drilled as before, but in this operation the center has been shifted toward the top of the holder a distance equal to one-half the diameter of the hole, so that the new hole is half within and half without the steel insert.

The Broaching Operation

At the point where the hole breaks through on the bottom of the forging the metal has been cut away with an end mill to obviate the difficulty encountered in drilling a half hole, and also to provide against crooked holes and tool breakage in the broaching operation which follows:

Fig. 6 shows the broaching machine with the fixture in place for holding the offset tools. This fixture

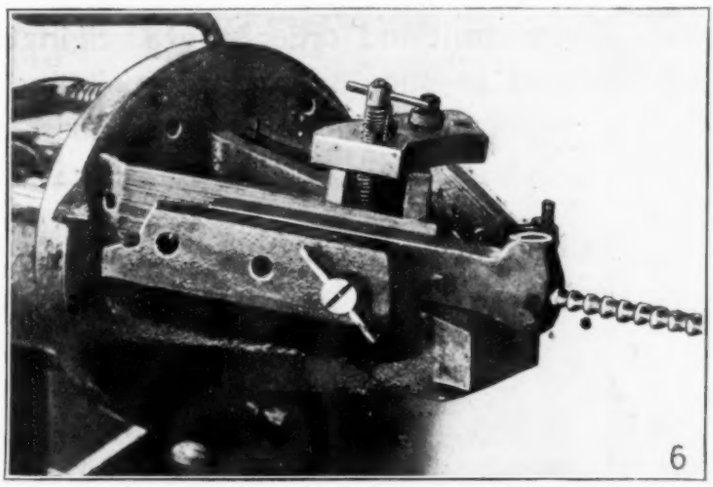


FIG. 6. BROACHING THE SQUARE HOLE

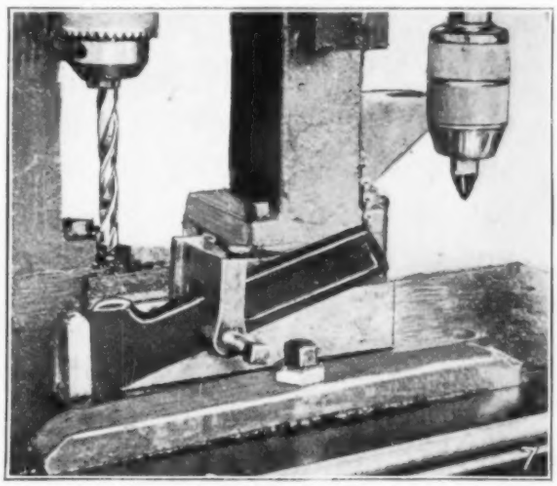


FIG. 7. DRILLING FOR THE SETSCREW

accommodates tools of either hand by merely changing clamping screws from one side of the fixture to the other. The straight-shank tool requires a different fixture.

The hole for the setscrew is then drilled and countersunk in the fixture shown in Fig. 7, the fixture being bolted to the table of the drilling machine, and no guide bushing is needed. The countersink shown in the second spindle removes the corner from the hole providing for the entry of the tap in a later operation and avoiding a ragged edge on top of the tool when the thread is cut. The countersinking is done with the work held in the operator's hand after the drilling is done.

Ready for Packing and Shipment

The tools are given two hardening operations, the makers believing this treatment to make the center of the tool tougher and stronger. The first hardening heat is 1650 deg. F., and oil is used for the quenching bath. They are then ground and polished, after which they are given the second hardening by heating to 1400 deg., dipping in cyanide and quenching first in water and then in oil, this last operation giving the tool that mottled appearance so familiar to the trade. The final treatment is the heating of the tools to 400 deg. to remove hardening strains, after which they are allowed to cool slowly.

The tools are then made ready for packing and shipment.

Cutting a Four-Spline Gear Without Special Tools

By R. C. Thompson

Referring to V. C. Bowser's article on page 1095, Vol. 49, of the *American Machinist*, for cutting four-spline gear without special tools I wish to take exception to the editor's note that "there are two cuts too many in this plug. If the cutter slot and first keyway are accurately spaced to 90 deg. no other keyway is necessary."

My criticism is that if the cutter slot and first keyway are absolutely accurately placed this statement would be correct, but if the plug is made in this manner with the cutter slot and one keyway and there is an error in the placing of the slot and keyway or an error in the first slot due to shake of cutter bar in the slot this error will be multiplied in moving the plug from position to position, thus giving four times the error between the position of the first and last slot that existed in the plug. If the plug is made as shown in Mr. Bowser's sketch this error will not be increased, but the gear will be splined as accurately as the plug.

I raise this point because it is one which is so frequently lost sight of in designing jigs for a sequence of operations on a part, and the tool designer instead of sticking to one locating point changes his locating point with his operations, thus permitting an accumulation of errors. It seems to me that so well known an authority as the editor of the *American Machinist* should not uphold a fallacy of this kind.

[We cheerfully admit the impeccability of Mr. Thompson's criticism from a practical standpoint, but still insist that four times 0 = 0, and were the conditions implied by our "if" in the comment accompanying Mr. Bowser's letter fulfilled there would be no need for the extra keyways in the plug. It is well to avoid the possibility of multiplication of error where it can be done without sacrifice of other desiderata, but we can testify from our own experience that progressive location is by no means impractical. In our shop experience many years ago we made a tool that involved exactly the same principle as Mr. Bowser's plug, but in which the "multiplier" was 42 instead of 4.—Editor.]

A CREED *for* MACHINE

I believe in the dignity of foremanship, responsibility of leadership.

I Believe in My Firm. Its good name is my good name, and I will actively protect it against slander and strive to elevate it by example. To the men in my charge *I am the firm,* and by my acts they will judge it to be good or bad.

I Believe in Our Product. To keep its quality unquestioned I will make every effort to have good work rewarded, poor work bettered and worthless work eliminated. I will study the uses of our product and tell those who work upon it not only How but Why.

I Believe in Myself. I will swing this job of mine better than any other man could swing it. I will know how long each job takes and how long it should take. I will let each man know that I know not only what he does but what he can do and should do. I will shoulder responsibility, standing back of orders that I transmit and orders that I originate, and in shouldering responsibility I will also shoulder consequences.

I Believe in My Men. Responsible for directing their work, and thus for shaping their lives and the living of their dependents, I pledge myself to the square deal and the helping hand. I will make fit and not misfit. I will see that each man gets a right start and that he continues to get and to give a square deal. I will listen patiently to all suggestions, explain the impossible ones, test the probable ones and give credit and show appreciation for the successful ones. I will let no man quit without my knowing why and, if possible, doing away with the cause.

I Believe in Good Machinery Plus Brains—that their partnership is necessary for production. I will see to it that good machinery gets good treatment and that poor machinery

SHOP FOREMEN

By John H. Van Deventer

in the honor of service and in the —I Believe in My Job.

is either bettered or scrapped. I will tolerate no "deadheads" either of flesh or of iron. I will lead my men and drive my machines, abusing neither. I will strive to make cutting tools cut costs as well as metal.

I Believe in Progress. I will encourage initiative, awaken ambition, foster skill and further the obtainment of knowledge in myself and in my men. I will set a mark and live up to it. I will achieve some definite gain each year in production, some improvement each month in methods, some advance each week in technical knowledge and a step forward each day in leadership.

I Believe in Team Work. I will have it said of me, "There's a man who will always co-operate." Of my department I will have it said, "Those fellows pull together." To these ends I will cultivate in myself the pride of leadership and the joy of accomplishment and will teach my men to know the satisfaction of excelling and the pleasure of being a winning team.

I Believe in the Future of My Industry—that the machine tool does as much for human progress as the surgeon's knife or the judge's library; that foremanship is a profession and not a trade. To advance myself in this profession I will search out new methods as the physician searches out new medicines; study current practice as the lawyer studies current decisions; inspire myself with the essentialness of my work as the clergyman inspires himself with the holiness of his mission.

* * *

So that when my work is finished men will say of me, and my conscience will say to me, "The world is better for your having lived in it and your industry is better for your having worked in it."

Additional copies of the above editorial will be furnished on request.

Details of Liberty Motor Development

By MAJ.-GEN. GEORGE O. SQUIER
Chief Signal Officer U. S. Army

IN APRIL, 1917, when this country entered the war there were being built in the United States only four makes of engines that could be considered of any military value, and even these were useful only for primary training. We had no engines at all suitable for services on the battle front or even for the advanced training of pilots. The largest engine of domestic manufacture developed about 220 hp. and had not proved satisfactory when judged from the standpoint of combat-service requirements. The others ranged from 90 to 135 hp. It therefore was evident that the existing American engines could be used for preliminary instruction purposes only, and that their further manufacture should be limited to training. This was done, with the result that by far the greater portion of the primary training of pilots has been conducted with the Curtiss OX-5 90-hp. engine, the quantity production of which was early obtained. This engine was particularly valuable, owing to the very satisfactory training plane which had been designed around it. The Hall-Scott A7-A 100-hp. engine was also extensively used at first until the production of the Curtiss engine could be brought to a point to meet all the demands of primary training.

Two European engines, the Gnome 100 hp. and the Hispano-Suiza 150 hp., were being put into production in this country early in 1917 by the General Vehicle Co. and the Wright-Martin Aircraft Corporation respectively. These concerns had obtained contracts with Great Britain and France, but were experiencing considerable difficulty in getting production under way. The first Gnome engine was not completed until more than nine months had elapsed, during which time English experts were present in the contractor's plant to aid the manufacture. In the case of the Hispano-Suiza, notwithstanding the assistance of a group of French experts sent over to help get it into production in the minimum time, 13 months were required to get the first production engine on the test block and another month before the first delivery was made. Preparation periods were filled with the most costly experiments and the development of methods and tools for performing the intricate operations required by the design of these engines. All of which expense and delay had cost our Allies dearly.

The Gnome and Hispano-Suiza engines represented the highest product of European design and were in a perfected and standardized state, according to foreign practice and conditions, when their production was undertaken in this country. Nevertheless the changes involved in adapting them to manufacture by American methods, and the development of expert workers for those operations which could not readily be so adapted, required so much time that the advances made in aeronautical engineering rendered such engines largely obsolete for service at the front by the time they could be produced in sufficient numbers to supply any material portion of the requirements.

These two engines were, however, of unquestioned value for advanced-training purposes, the Hispano-Suiza in particular being a dominant factor in this work. Later the LeRhone 80 hp. was put into production by the Union Switch and Signal Co., and by proper utilization of the lessons learned from our allies in the case of the other two foreign engines reasonably satisfactory progress was made in manufacture. This engine too was used for advanced-training work.

One of the serious mistakes the Allies had fallen into at the time the United States entered the war was the development of a multiplicity of types of engines and planes, which made it impossible to have a large number of any one of these types. As a further consequence the trained personnel on the ground to operate and repair the machines had grown to such a proportion that it was estimated that from 30 to 50 men were required on the ground to keep each one of the many types of planes in the air on the fighting line. Manifestly unless this large number of trained men per fighting plane could be reduced by some means it would be hopeless to expect within a reasonable time to put into the air thousands of flying planes, because a single thousand planes on this basis would require from 30,000 to 50,000 men in attendance.

The experience obtained in getting two foreign engines into production in this country and under our manufacturing methods so thoroughly demonstrated the futility of attempting any such solution of our service-engine problem as to at once eliminate its continued consideration. It was realized that copies of foreign designs could not be available in time and in adequate size or numbers to answer the demands of overwhelming air forces at the front. American air performance would have been very small indeed if limited by such a handicap as this.

Moreover, in spite of the fact that a technical commission was at once organized and despatched for the purpose of getting first-hand information on the front and in the aircraft centers of Europe, it was unthinkable that this country should sit idly by and wait perhaps months for the final definite report which should decide the nature and extent of our part in the allied aircraft program. Since the most successful airplanes are designed around specific engines and the engine involves the greatest expenditure of time and effort in development it was apparent to a few of us who were in close contact with the situation that it would in all likelihood be possible to design, develop and practice an entirely new American engine embodying characteristics that would render it particularly adapted to manufacture under American conditions in less time than would be required by the commission to determine the particular European engines that offered the best approximation to the various exacting requirements of service and production plus the time to get it in production in this country. It was decided therefore that our efforts should be directed along both these channels simultaneously and, in addition, to purchase in Europe whatever service equipment might be available to tide over the interval while we were getting into production.

It is apparent that the fundamental unit of engine design or construction is the cylinder and that the evolution of engine power rested mainly with the unit-power capacity of that cylinder which could be taken as representing the largest practicable size governed by the state of the art at that time. Starting with the foundation of this cylinder then it was the most direct reasoning to conclude that all requirements of the service for engines of varying power capacities could be most logically met by combining these unit cylinders into groups of whatever number were required to produce the several sizes of engines desired.

This was done, and the cylinder size of 5-in. bore by 7-in. stroke was selected, after a careful examination of the performance of both American and European engines of the then most modern design, as being the largest that could be relied upon to give satisfactory service. While originally designed to produce approximately 28 hp., this cylinder has been so developed as to yield at present more than 40 hp. as the result of somewhat increasing the speed and altering the functioning characteristics. The standard-unit cylinders were to be used in engines having four or more cylinders each and yielding the following power outputs:

Number of Cylinders	Original Rated Horsepower
4	110
6	165
8	225
12	335

Thus, for the first time in the history of the aeronautic engine for military uses, a truly comprehensive design

*Excerpts from address before the American Institute of Engineers, Jan. 10, 1919.

plan was evolved which in a simple and direct manner provided for the production of a whole line of engines of wide power capacities, but composed of units that were highly standardized and therefore could be really manufactured instead of being merely built. This was and is the only way in which this country could meet the requirements of this most vital part of the program.

It must not be thought, however, that such a revolutionary decision was easy to make or adhere to when made in the face of all kinds of adverse criticism, some of which seemed to be based upon adequate grounds. The development of new types of aircraft engines heretofore had been such a time-consuming matter that it was generally regarded as a thing to be avoided if any ready-developed engine could be found anywhere which would at all answer the requirements. Thus the numerical preponderance of opinion was against the possibility of a standardized American engine being designed, developed and produced in large numbers in anything like the short time required to duplicate some European engine. The nation may well render thanks that its destinies in this particular were guided by such a farseeing and courageous group of men who had the ability to formulate such plans and then to enforce their realization.

You are all familiar to some extent with the history of the design and construction of this engine; how Lieut.-Col. J. G. Vincent of the Packard Co. and E. J. Hall of the Hall-Scott Motor Car Co. laid down the general features and got out the first assembly drawings personally between midday of May 29 and the afternoon of May 31, 1917, working in Col. E. A. Deed's apartment in a Washington hotel in response to a request for a report on the aircraft-engine situation, which came from Howard E. Coffin, chairman of the Aircraft Production Board; the chief signal officer of the Army; Col. Edward A. Deeds, chief of the Equipment Division, Signal Corps, and Col. Sidney D. Waldon, assistant Chief; how the order to build 10 sample 8s and 12s was given as the result of the approval by the joint conference of the Army and Navy Technical Board and the Aircraft Production Board; how the first engine, an eight cylinder, was built in one month as the result of the enthusiastic coöperation of some 10 manufacturers, each of whom produced those parts for which he was best fitted; how the first sample 12 cylinder finished its official 50-hour endurance test 82 days from the time the order for samples was given, and that the total elapsed time during this test was only about 55 hours, a record-breaking performance, and how the success of this endurance test definitely removed the engine from the experimental stage to the realm of proved engines.

Gratifying Endorsement

A very gratifying endorsement of this standardized engine project came from the late Col. R. C. Bolling, whose untimely death in France cost the American Air Service one of its most valuable officers, and Col. V. E. Clark, and Lieut.-Col. Howard C. Marmon, members of the commission sent abroad to ascertain the requirements and which returned about this time, to the effect that a 400-hp. engine was absolutely demanded at the front for the types of airplanes which it had been decided this country should supply and that no engine of this size then existed in Europe.

Those of us who are familiar with the difficulties and disappointments involved in the design, development and perfection of any form of intricate mechanical device can readily appreciate the really remarkable accomplishment represented in the Liberty. Therefore it is not at all surprising that the representatives of the Allies were for some time unable to believe the full truth of this accomplishment. They never had been able to obtain such action and were naturally only fully convinced after many varied and exhaustive tests. So well recognized did the value of the Liberty engine become, however, that the Allies had on order at the time of signing the armistice 16,741 Liberty engines and were constantly endeavoring each to increase their rate of monthly delivery. Airplanes were being designed around this engine in all allied countries and it was fast becoming the predominating aeronautical engine of the allied cause.

It is of interest in this connection to note that this standardized engine already has been tested in the 24-cylinder model and had shown results which prove that the original basic idea will provide for engines of any size which would have been required for any probable increase in airplane size during years of continuation of the war. The 16-cylinder was also proved by the success of the larger engine.

The experimental development of the Liberty has been in charge of a department entirely separate from that dealing with its production, the Airplane Engineering Department under Lieut.-Col. J. G. Vincent and Lieut.-Col. Howard C. Marmon. The work of this department has resulted in a continuous improvement of the power output and performance characteristics of the Liberty 12 cylinder to such an extent that 526 hp. has been obtained with special fuel and detail changes, certainly a remarkable increase from the 335 hp. which the original design was intended to yield. While the weight of the service engine per horsepower has remained at approximately 2 lb., the maximum present development had reduced this figure to 1⅛ pounds.

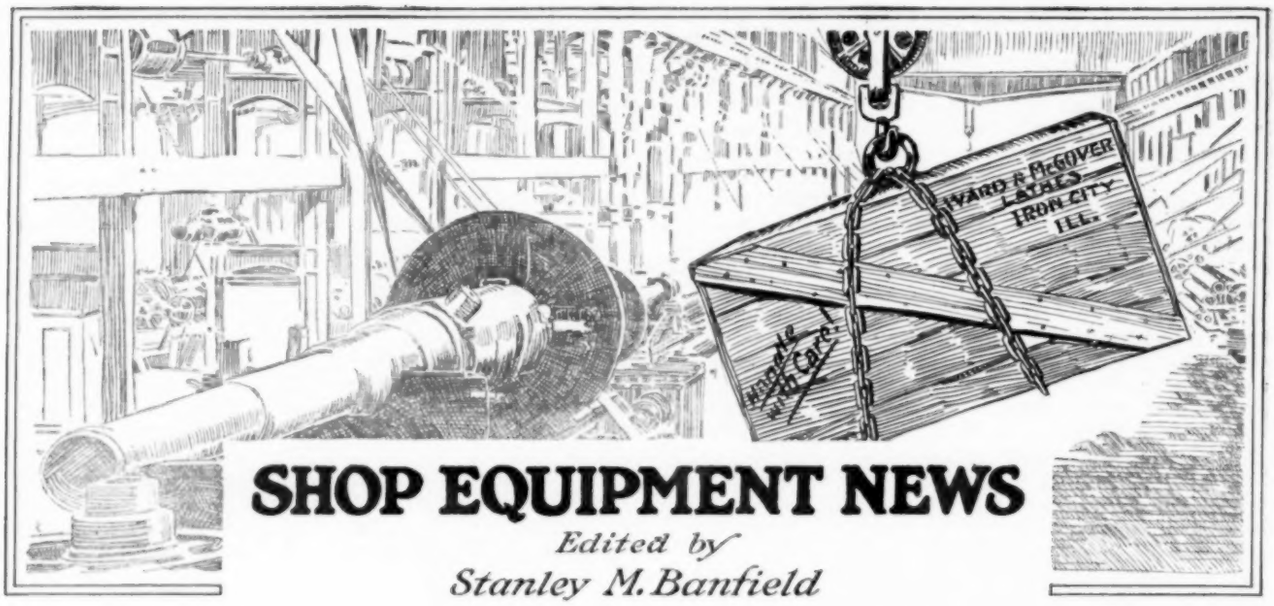
Liberty Engine Development and Production

The record of production and production development of the Liberty conclusively proves the wisdom of the decision to concentrate all efforts on this one engine for the major part of our program of combat engines. In common with all similar machines many possible improvements and cost reductions become evident as the manufacturing processes and tools are being evolved and as experience is being acquired in the actual production. Also experience in the operating and adjustment of these engines led to alterations being made which resulted in increasing the power output, so that when we were advised that more power was desired than the 335 hp., which the original Liberty was designed to produce, the necessary stops already were known and the delay incidental to putting them into effect was small. The resulting power increase to about 375 hp. answered requirements for several months when advices were again received that more power was needed, and we then again made such alterations as were required to increase the power to around 420 hp. The weight of some of the parts was increased at this time in order that the reliability might not be reduced.

The problem of production was placed in the hands of a separate department in charge of Lieut. H. H. Emmons, U.S.N., and the continuous assistance of such men as Henry M. Leland of the Lincoln Motors Co., C. Harold Wills of the Ford Motor Co., F. F. Beall, O. E. Hunt and Edward Roberts, all of the Packard Motor Co., were obtained by Maj. J. G. Heaslet in charge of the Detroit district. The work of Mr. Wills, which has the greatest value, was the perfection of a new process for the forging of cylinder blanks in sufficient quantities to supply all manufacturers, and which was so very effective that the problem of cylinder-forging supply and cost was reduced to a minor consideration. The wisdom of the action taken is evidenced by the production of 1100 Liberty 12s in one year from the day when Messrs. Vincent and Hall first met and started a preliminary drawing and over 15,000 by the end of another six months.

It is perhaps to be expected that many criticisms would be leveled at an engine evolved under the condtions obtaining at that time and registering the large success which it represents, but all such have proved to be the result of misinformation regarding the conditions to be met, the fundamental ideas of design or of lack of appreciation of the difficulties encountered in creating at a single stroke and without previous experience an aeronautical power plant so much larger than was then in existence.

The Liberty engine stands today as an achievement which for daring, constructive imagination and farsightedness will ever be a cause of pride to the American people.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Terkelsen & Wennberg Lathe Chucks

Terkelsen & Wennberg, 326 A St., Boston, Mass., have recently put out a line of lathe chucks, as shown in the illustrations, which are believed to have several features

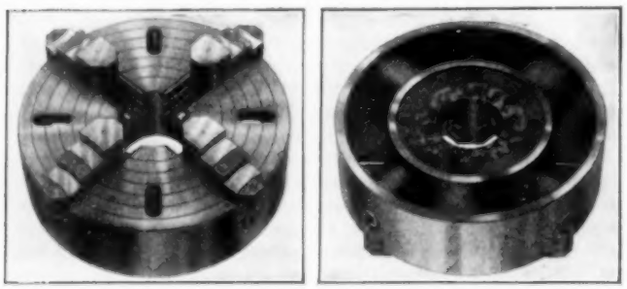


FIG. 1. FRONT AND BACK OF THE T-W LATHE CHUCK

that make them particularly desirable. The body is of heavy single-piece construction and is ground to a finish. The back of the body is not slotted, which is claimed to give it exceptional strength, and thrust bearings are provided at the end of each screw. The jaws are double gibbed, of 30- to 35-point carbon steel, heat-treated and ground all over and are interchangeable. The

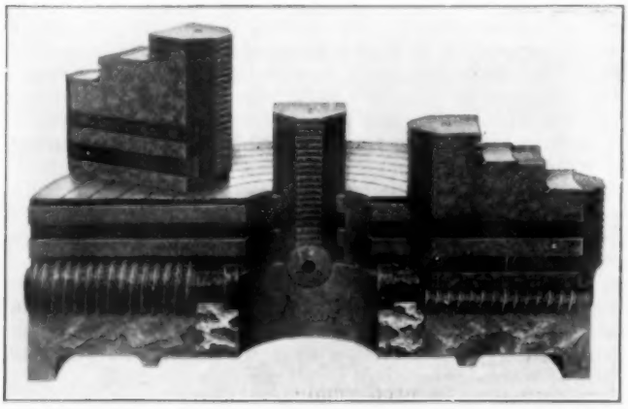
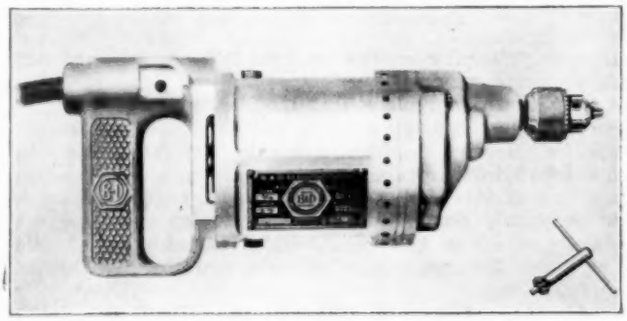


FIG. 2. A CROSS-SECTION OF THE CHUCK SHOWING THE INTERNAL CONSTRUCTION

double-gibbed jaws are claimed to give longer life and greater accuracy than those of the single-gib type. The scrolls are made of 60-point carbon-steel forgings, while the pinions are 50-point carbon steel heat-treated and interchangeable. The threads on the screws are cut from end to end without any necking except at the lower end for the thrust ring, and can be easily removed for reversing the jaws or for cleaning. The thrust ring is made in one piece of solid steel. It is also said that the construction of the chuck brings it closer to the lathe spindle, which tends to make it steadier and to eliminate chatter.

Black & Decker Electric Drill With Pistol Grip and Trigger

The electric drill shown in the illustration is one of the latest products of the Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md. The



BLACK & DECKER ELECTRIC DRILL

machine is equipped with a pistol grip and trigger switch and is claimed to be the lightest machine of its capacity on the market. Its weight is only 6¾ lb., and its capacity is drills up to $\frac{3}{16}$ in. in diameter. The overall dimensions are 4 in. in diameter by 12 in. long and a series-compensated motor furnishes the power. A no-load speed of 1600 r.p.m. is attained, dropping to 1000 r.p.m. at full load when the energy consumed is 175 watts.

Landau Back-Geared Tapping Attachment

The back-geared tapping attachment shown in the illustration is one of the recent products of the Landau Machine and Drill Press Co., Inc., 19-25 West 44th St., New York. The device is at present made in two sizes, No. 1 taking taps up to $\frac{5}{16}$ in. and No. 2 taps from $\frac{1}{4}$ to 1

LANDAU BACK-GEARED TAPPING ATTACHMENT

in., both being fitted with standard Morse taper shanks. The construction of the device is such that it will work to the full length of the tap. When the tap reaches the bottom of the hole it is automatically released to prevent breakage. The back gears are used to reduce the speed of the tap, the reversing speed being 7 to 1. All parts are hardened and ground and the gears for both tapping and reversing are constantly in mesh. The No. 1 attachment is equipped with a Jacobs chuck.

"Safety Is Patriotism and Carelessness Is Disloyalty"

BY LUTHER D. BURLINGAME

The slogan "Safety Is Patriotism and Carelessness Is Disloyalty," given out by the National Safety Council in the interest of reducing accidents, so that man power might be conserved for efficiency in war work, applies also to after-war conditions.

In looking at the losses sustained by the American forces in the short time they were in active service we feel that these losses were a heavy toll; but when we compare them with the casualties of industry in times of peace we find that in spite of all efforts toward safety so far made—and there have been great strides in that direction—figures are appalling.

Charles M. McChord of the Interstate Commerce Commission reports that 35,000 workmen are killed by industrial accidents every year, or one every 15 min. every day in the year, and 2,000,000 workmen are injured, or one every 16 sec. Such figures make the casualties of the American Army in the war seem small by comparison, and should bring home to every employer and workman the need of taking further steps to safeguard life and to adopt methods of work which will prevent this drain on our industrial efficiency. This drain, mark you, does not let up with the coming of peace, but continues year after year, and while not spectacular it goes on taking its toll of human life and limb with too little notice on the part of the public and of those responsible for its reduction.

Pan-American Engineering Organization

An ambitious project named the Pan-American Engineering Organization has been proposed by W. H. Woodbury, of Duluth, Minn. It will include such engineering bodies as the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials, the Society of Automotive Industries and other similar organizations. It is intended to use the local sections of the various societies for maintaining local interest, and it is proposed that members of other societies take out membership in the Pan-American Engineering Organization, and that this includes civic and social activities as well as those of the strictly technical societies.

Another object of this organization is to tie the technical man more closely to the affairs of his city or town by interesting him in the engineering and other activities and responsibilities of his own locality.

The Belgian Industrial Committee

The Belgian Consul, 25 Madison Ave., New York, sends us the following:

"I have just received through the courtesy of the Belgian Legation in Washington the following telegram from the Belgian government, which I think may interest you and is transmitted for your guidance, concerning the revival of industry in Belgium:

"In answer to your telegram, No. 599, the best organization to satisfy the demands of American merchants and manufacturers is the Comité Central Industriel de Belgique, Onze, rue du Gentilhomme, Bruxelles. The government is compiling documentation concerning the present condition of the Belgian industry. The Comité Central Industriel is requested to make list of names and addresses of Belgian firms for principal articles. These documents will be transmitted later on."

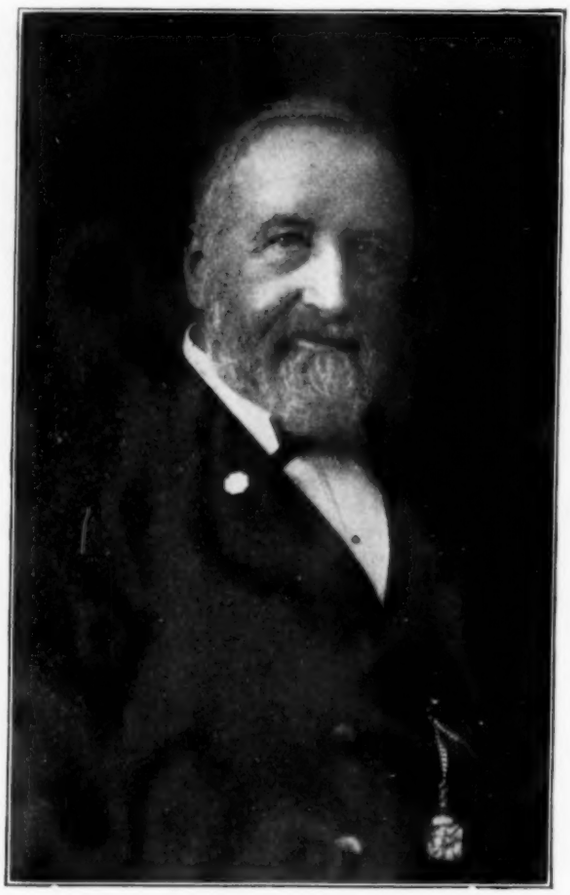
Omission

In the article "A Modern Can-Making Plant in a Baking Powder Factory," page 1173, Vol. 49, the name of Torris Wold & Co., Chicago, makers of the machinery described, was unintentionally omitted.

Angus Sinclair

Angus Sinclair, well known as the editor and proprietor of *Railway and Locomotive Engineering* and as the author of several books, died at his home in Millburn, N. J., on Jan. 1 at the age of 77.

Born in Scotland, Angus Sinclair first went into the British customs service, and those who knew him well recall some of his quaint stories of those early days. Later he sailed the seas in the engine room of ocean-going vessels and finally came to this country, going into railway work in the Middle West. He was a tireless worker, and soon after his arrival made himself known as a writer on railway topics. In this way he became acquainted with the late George Westinghouse and probably wrote the first railway-man's description of the air brake. Railway literature was scarce in those days, and Sinclair's book on "Locomotive Running and Management" became the guiding star to many a young railroader who was anxious to get to the top; and although he wrote a number of other books, among them a comprehensive history of the locomotive, "Locomotive Running and Management" will remain as his monument in this line. This has gone through 26 editions, the last revision being in 1915, so that this may be said to be his first and at the same time his last book. His book on "Firing Locomotives" has been translated into eight languages, including Chinese.



ANGUS SINCLAIR

In June, 1883, Angus Sinclair became an associate editor of the *American Machinist*, having previously contributed to its columns, as has been the way with all its editors since the beginning. He remained for about two years, leaving in May, 1885, to take up in Chicago the editorial work on the *National Car Builder*, which is now merged into the *Railway Age Gazette*.

In due time he became editor in chief of the *Car Builder*, with headquarters in New York, and when John A. Hill came to New York to edit the *Locomotive Engineer*, which was born in 1888, they soon became fast friends. This friendship grew until in 1892 Sinclair left the *Car Builder* to become senior partner in the firm of Sinclair & Hill, which bought *Locomotive Engineering* from the old publishers of the *American Machinist*.

This was a winning combination, and needless to say they prospered beyond all expectation. Then, by one of the strange turns in the wheel of fate, the firm of Sinclair & Hill, which the old management had given six months to live, bought a controlling interest in the parent paper, the *American Machinist*. It was a bold stroke and required nerve, but they knew the latent possibilities of both papers, and the result is known to all.

After five years of strenuous work in building up both properties to a substantial basis the partners decided that it would be better for each to specialize on one paper, so that in June, 1897, Sinclair took *Locomotive Engineering* and Hill the *American Machinist*. Then the name was broadened into *Railway and Locomotive Engineering* and the paper has made an enviable reputation for itself under the personal guidance of Angus Sinclair, who did not until very recently entirely give up the reins of management. Long years ago, however, in addition to his literary work—and he was a prodigious worker and writer—he was first secretary and later treasurer of the American Master Mechanics' Association, and as such became known to practically every railway official in the country. About ten years ago he received the degree of doctor of engineering from Purdue, and for eight years was a special instructor in the mechanical department of the Erie Railroad.

Mr. Sinclair was one of the early devotees of the automobile, beginning with the old steam car, and also published for a time the *Automobile Magazine*, one of the pioneers papers in the field. He was a member of the American Society of Mechanical Engineers and of nearly all the railway associations, and was a Knight Templar in the Masonic fraternity, a governor in the St. Andrews Society, a former president of the Burns Society and also of the St. Andrews Society of Newark, besides being a member of the American Railway Guild, the Lawyers' Club, the New York Railroad Club and numerous other railway, Scottish and other societies. He is survived by his wife Medora Head Mullin Sinclair.

His friends, and they were many, will miss him from his accustomed place at conventions and other engineering meetings. Few men had a wider acquaintance and few will be more kindly remembered.

LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft · Motor Trucks · Tractors

The Government has returned the Milwaukee Ford assembling plant to the company, which will go into operation on Apr. 1, 1918, at a daily production of 200 cars.

The Bureau of Aircraft Production, as a consequence of the stopping of hostilities, has restored the normal commercial position of the use of black walnut by canceling all restrictions placed on it.

The White Co., in addition to the four standard commercial-truck models, offers for 1919 a new "Good Roads" model, which is a 5-ton, chain-driven truck having a six-cylinder engine and steel wheels with wide steel tires instead of those made of rubber.

The present standard mail plane carries 700 lb. of mail. In the months of July and September 33,500 lb. of mail were carried at a total cost of $17,420. Of this $5800 was paid for pilots and mechanics. The De Haviland army planes are to be abandoned in favor of Curtiss R-4 with Liberty motors.

The Post Office Department has increased its requisition with the War Department for motor trucks from 10,500 to 15,700, and as a result it is now expected that the truck orders for commercial trucks placed with the Locomobile, Pierce-Arrow, Packard, Garford and White companies will not be canceled.

Announcement is made that plans are maturing for the exploration of the north polar regions next summer by means of airplanes. The plan calls for the raising of $250,000 by the Aero Club of America, the taking of a ship to Etah, which is located about 600 miles from the pole, and the exploring of the polar regions by land machines or seaplanes.

The 3 per cent. sales taxes collected on automobiles, motorcycles, etc., in the fiscal year ending June 30, 1918, amounts to $23,981,268. In this total amount of taxes Michigan is represented with $14,800,679, Ohio with $3,152,133, New York with $1,890,511 and Wisconsin with $1,236,679. The following states did not pay any part of the automobile sales taxes: Alabama, Alaska, Arizona, Colorado, Delaware, Florida, Hawaii, Idaho, Maine, Montana, New Mexico, North Dakota, South Dakota, Utah, Vermont, West Virginia and Wyoming.

An international aeronautical exposition is to be held in Madison Square Garden, Feb. 27 to Mar. 6 inclusive. This aircraft exposition was approved by President Wilson's first proclamation issued from France. Through the coöperation of the War Department certain war trophies and military features will be the center of interest.

The advantage of the four-wheel drive on a tractor is that all of the weight of the machine and driver is available for traction purposes. The weight of the tractor being equally divided between the four wheels the tractor will not pack the soil as hard as would one having the bulk of the weight on two driving wheels. The four-wheel drive naturally complicates the construction; still this drive has proved successful in motor-truck work during the war and even essential in the work of the Ordance Department.

One of the most interesting developments of the war in the air has been the invention and application of the aerial telephone for directing of air craft. Its successful application as an important airplane equipment is due to the work of Col. C. C. Culver. On June 1, 1918, at Gerstner Field, Louisiana, 39 airplanes equipped with radiophones were paraded in review before Maj.-Gen. W. L. Kenley, who occupied a plane with the flight commander and personally directed some of the formations by using the radio-telephone equipment. With this apparatus aviators can talk 25 miles through the air in excellent atmospheric conditions, while in the worst weather the talking is possible for a 6-mile distance.

The Salvage Branch of the Supply Section of the Department of Military Aeronautics has invited sealed bids for the following material: 1000 Standard J-1 airplanes equipped with Curtiss 0 x 5-90 engines at Houston, Tex.; 200 Standard J-1 airplanes with Hispano-Suiza 150-hp. engines at Houston, Tex., Standard J-1 airplanes without engines, Houston, Tex.; 10 L. W. F. airplanes with Thomas 135-hp. engines at St. Paul, Minn.; 2000 A-7-4 four-cylinder Hall-Scott engines at Houston, Tex. The bids will be opened at 11 a.m. on Feb. 1, 1919, at the office of the Salvage Branch, Washington, D. C. Each bid must be submitted in duplicate and accompanied by a certified check for 20 per cent. of the amount of the bid. The terms will be cash f.o.b. location given and delivery within 90 days.

Interesting features of the French Breguet biplane are the wing spars and the interplane struts. The spars of both planes are drawn-aluminum tubes of rectangular section $2\frac{13}{16}$ in. x $1\frac{33}{64}$. The wall thickness of these tubes is in the inner section of the upper plane approximately $\frac{7}{64}$ in., and $\frac{1}{16}$ in. elsewhere. The rear spar grows thinner toward the wing tips. On the wing tips auxiliary spars are provided with ash bands of $\frac{17}{64}$-in. thickness and $\frac{1}{8}$-in. three-ply wood glued to both sides. At the points of junction and at the ends of the stampings the spars are strengthened by ash pieces, in some instances of I-shape. The sockets and the wooden linings are held in position by iron-tube rivets. The interplane struts are made of stream-lined aluminum tubes with aluminum sockets in both ends. The inner struts are strengthened by the insertion of riveted U-irons.

The next logical step to be met in the problem of liquid-fuel conservation is the design of an engine especially suited to the burning of kerosene or fuel oils and not the attempt to adopt engines designed for gasoline to the use of kerosene or heavy oils. The present type of gasoline engine does not burn kerosene successfully even at full load, because kerosene and gasoline are widely different substances, having little in common except that they are derived from the same petroleum base. Gasoline mixtures ignite spontaneously at about 680 deg. F., while a kerosene mixture self-ignites about 575 deg. F. Kerosene will not volatilize at ordinary temperatures and pressures, and for the vaporization the assistance of heat is necessary, but even then is not sufficient to produce a homogeneous mixture of oil, vapor and air. Attempts to apply heat frequently fail of their object because the heating of the air decreases its density, reduces the amount of oxygen and thus cuts down the power output. An ordinary electric spark will usually fail to ignite a mixture of heavy oil and air, because the source of heat is too localized and the flame propagation is much slower than in the case of gasoline vapor mixed with air. For these reasons some means other than carburation must first be provided with a heavy fuel engine for an intimate mixing of the fuel and the air, and some means of igniting this mixture other than an electric spark is necessary. The future of a successful kerosene or heavy-oil engine is closely connected with the future developments of the Diesel and semi-Diesel engines.

Sparks from the

Latin-American Market for Tractors

Lack of Transportation Facilities Acutely Felt But Tractors Are Proving Successful in Road Work

The extensive areas of agricultural land in Latin-American countries offer a rich field for the development of trade in farm tractors. Many of the estates, comprising hundreds of thousands of acres, still cultivate their crops of grain, sugar and cotton under the old systems that require large numbers of laborers and horses. Power farming on these great plantations invariably shows economy of time and expense, and the recent increase in shipments of tractors from the United States to Latin America indicates that the more progressive ranch owners are beginning to realize the value of new methods. In the fiscal year 1918 more tractors were shipped from this country to the Latin-American countries than in all the four last years preceding, and in the first quarter of the 1919 fiscal year these exports amounted to more than a third of the total 1918 shipments.

VALUE OF TRACTOR INCREASING

The direct cause of this unprecedented demand for tractors in Latin America is doubtless the awakened interest in agriculture growing out of war-time needs and prices. The value of the tractor in increasing the agricultural production of Latin America is almost equaled by its importance as a road maker. The lack of transportation facilities is acutely felt in some of the richest sections of South America, and the tractor is proving of incalculable advantage in the construction of needed highways.

One of the chief obstacles faced by the manufacturer in the introduction of tractors is the natural aversion of a conservative rural community to new and complicated mechanical appliances. Inexperienced operators, failing to meet with success in the use of an untried machine, condemn and abandon it. The manufacturer must prepare to overcome this difficulty by providing ample instructions and demonstrations, and should moreover take special pains to furnish the proper kind of tractor for the particular class of work desired.

Another obstacle in selling tractors in Latin America is the high cost of gasoline, but it is probable that with the close of the war there will be a reduction in the price of this fuel. In contrast with the scarcity of fuel for tractors the ranch owner has available a large supply of horses and practically unlimited natural pasture, making his outlay for animal power comparatively small. To meet this condition the manufacturer must demonstrate that the land can be much more quickly and evenly worked and to a much greater depth with the use of the tractor than is possible with animal power; he must show that in the planting season not an hour need be lost because of a scarcity of laborers or horses, every moment can be utilized by the tractor, and the fields can be plowed, harrowed and planted at the most favorable period to insure a good harvest.

The Latin-American countries that are foremost in experimenting with tractors are Mexico, Cuba, the French West Indies, Haiti, the Dominican Republic, Guatemala, Nicaragua, Panama, Salvador, Argentina, Brazil, Chile, Colombia, Paraguay, Peru and Uruguay.

* * *

Mr. Manufacturer, Lend Him a Hand

The editorial supplement which accompanies this issue of the "American Machinist" is an appropriate one at this time, as it portrays the much needed assistance that must be given those boys who are returning home from the camps and battlefields and who are seeking positions in the country's industries. Will you, Mr. Manufacturer, lend him a hand?

New Process Gear Corporation Sold to John N. Willys

John N. Willys has purchased outright the New Process Gear Corporation, Syracuse, N. Y., taking over all of the $3,000,000 capital stock of the concern. There is no change contemplated in the nature of the product the company will manufacture, although it is naturally expected that material expansions in the old field will result. It is the intention of the company to solicit gear business of all kinds, and particularly so far as the manufacture of gears relates to differentials and transmissions for the automobile trade.

Thomas W. Meachem and other members of the Meachem family connected with the corporation have retired, having sold their interests to Mr. Willys. On the latter's part this step represents final complete acquisition of a plant in which he previously has been partly interested. No change of active management has been intimated, immediate control of the enterprise being in the hands of J. Allen Smith.

Candles Enough to Last for 5250 Years

The signing of the armistice left the American Expeditionary Forces with a quantity of candles aggregating 7,600,000 pounds, or 46,000,000 individual candles. Each candle made under Army specifications burns 10 hours, and on this basis it has been figured that the quantity of candles on hand is sufficient to burn one candle continuously and without interruption for 5250 years.

The primary use of the candles was to furnish light in the trenches and dugouts, but there is also a very extensive use for them in billets and camps. The supply of candles on hand, while large, is probably no greater than the amount necessary to meet the requirements of the Army for the immediate future.

* * *

Huge Mineral Output in 1917

The value of the minerals produced in the United States in 1917, according to the United States Geological Survey, Department of the Interior, was $5,010,948,000, an increase of $1,496,976,000, or about 43 per cent. over the former record—$3,513,972,000—established in 1916.

The metals established a new record in 1917, being valued at nearly $2,092,000,000 and representing 42 per cent. of the total value of the mineral product. They showed an increase of about $471,316,000, or 29 per cent., over the $1,620,508,000 reported for 1916. The blast-furnace products contributed nearly 90 per cent. of the total increase. Increases were also made in the value of aluminum, copper, lead and silver, but decreases were recorded in the value of gold and zinc.

* * *

Boston Bank Officers Will Go to Australia and the Far East

The First National Bank of Boston is sending two of its senior officers to Australia and the Far East to establish further foreign banking connections.

C. F. Weed, vice president of the bank, and D. A. de Menocal, vice president of the First National Corporation, will leave Boston about Jan. 20, sailing from San Francisco directly to Australia. After a few weeks in Australia, to be spent principally in Sydney and Melbourne, they will go to China and then return by the way of Japan.

Mr. Weed and Mr. Menocal have already had many matters for inquiry submitted to them. They had planned to be absent about four months, but if these inquiries multiply the trip may take longer.

World's Industrial Forge

By E. C. Porter, News Editor

Elevator Manufacturers' Convention

The Elevator Manufacturers of the United States held their semiannual convention at the William Penn Hotel, Pittsburgh, Dec. 4, 5 and 6. Among the subjects discussed were cost systems, coöperative service, elevator regulations, service stations and the prospects of the industry. Among the features of the occasion were a banquet, a theater party and a trip to the works of the Westinghouse Electric and Manufacturing Company.

The following officers were selected for the coming year: President, I. N. Haughton, Haughton Elevator Co., Toledo; vice president, O. P. Cummings, A. B. See Electric Elevator Co., New York; secretary, Frank A. Hecht, Jr., Kerstner & Hecht Co., Chicago; treasurer, J. H. DeVere, Ohio Elevator Co., Columbus.

* * *

Big Extension for Steel Mill

An extension involving an expenditure of $10,000,000 has been made at the Brier Hill Steel Co.'s new plate mill at Youngstown, Ohio. Construction was begun Aug. 17, 1917. The mill is designed to finish sheared plates up to 120 in. wide and any length up to 80 ft. Slabs will come from the blooming mill about three-quarters of a mile distant. When running at full capacity the mill is expected to turn out upward of 30,000 tons of sheared plates a month.

* * *

November Fire Loss

The fire loss during November in the United States and Canada was $12,333,750, and the total loss for the eleven months ended with November was $301,276,635. This exceeded the total for the year 1917, which in turn exceeded the total for 1916, and it was greater than for any entire year on record excepting 1906, when San Francisco was burned and the loss for the year ran up to $459,710,000.

* * *

Demobilization of Army and Navy Students at Stevens Institute

With demobilization of the Army and Navy units of the Students' Army Training Corps at Stevens' Institute of Technology, Hoboken, completed, there are left nearly 500 men who will go on with the regular mechanical-engineering course, only about 70 having withdrawn.

The demobilization of the entire Naval Section of the Students' Army Training Corps occurred on Dec. 21, 1918, with appropriate ceremony, after which the released students presented their commanding officer, Lieut.-Commander Frederick L. Prior with a gold watch.

War-time activity still continues in the United States Government steam-engineering school located at Stevens. This school has thus far graduated 10 classes of 20 to 30 men each, the graduating men being commissioned as ensigns in the engineering line and detailed to the Navy Auxiliary.

Brig.-Gen. C. C. Jameison Resigns from Service

Brig.-Gen. C. C. Jameison, late assistant to Major-General Goethals and in charge of the disposition of mechanical equipment purchased by the Government for the Ordnance Department, has resigned. Details are not obtainable, but it is said that General Jameison's health has been impaired by his strenuous activities. General Jameison, until a few months ago, was connected with the Ordnance Department, first with the Production Division in which connection he was instrumental in the development of much new plant capacity for munition work. Later, and before assuming responsibilities under the Director of Purchases, Storage and Traffic, he was one of the special assistants to the Chief of Ordnance.

* * *

Presidential Boom for Schwab

Seven hundred and fifty men representing the machinery construction and metal-working interests of the Middle West at the banquet on Superintendents' Night, Dec. 21, given by the Machinery Club of Chicago, proclaimed amid high enthusiasm Charles M. Schwab their presidential choice for 1920.

* * *

Found Places for 2,500,000 Workers

The United States Employment Service, under the Department of Labor, has found places for 2,500,000 workers from the time of its organization last January to Nov. 1. The employment service has announced that the number of its officers has been increased from 90 to over 900. It is expected that the service will be used very largely in the placing of discharged soldiers and sailors.

The Lyons Sample Fair of 1919

Affords a Good Opportunity for American Exporters to Demonstrate American Machinery

In view of present conditions and the approaching end of the war American participation in the Fourth International Sample Fair, which is to be held at Lyons, France, from March 1 to 15, 1919, becomes increasingly desirable and important.

Acting on the advice of the Department of Commerce the Department of State has allotted to the American consul at Lyons $1000 for the rental of space at the fair for the display of American goods and catalogs, following a precedent established in recent years. As a result three ways are open to manufacturers and exporters of the United States in which to exhibit at this fair: (1) A stand or several stands may be rented. The area of each stand is about 20 sq.yd., and the rental for the duration of the fair is 600 fr. ($116 at normal exchange). (2) Samples may be exhibited in the official consulate stand on payment of a fee to the fair committee of $25 for the privilege. (3) Catalogs may be shown in the consular stand free of charge. The consul and his staff will endeavor to give the widest publicity to these catalogs.

Each prospective exhibitor is required to fill out and sign an entry form, a copy of which may be obtained from the Bureau of Foreign and Domestic Commerce at Washington. Under no circumstances will any exhibits be shown unless the necessary forms are signed.

Manufacturers and exporters desiring to exhibit under plan 1 should write at once to the Comité de la Foire, Hotel de Ville, Lyons, France, giving complete information as to the character of their exhibit and inclosing the necessary fee for the stand or stands engaged. If on the other hand a manufacturer desires to be represented by catalog or sample in the consular stand under plan 2 or 3 this fact should be immediately communicated to the American consul at Lyons, France, and if samples are to be exhibited the necessary fee sent him.

It is needless to say that samples are a more potent selling force than catalogs, but catalogs are of course better than no exhibit at all.

Regarding the opportunity afforded by the Lyons fair for the promotion of the Franco-American trade, Commercial Attaché Williams reported from Paris under date of Nov. 22 as follows: "I recognize the value of the

Lyons fair in promoting the Franco-American trade. It should be especially useful to exhibit articles which France formerly imported from the Central empires, such as dyestuffs, glassware, etc. In my opinion the Lyons fair would also afford splendid opportunity for the display of American labor-saving devices and specialties for use in the household and on the farm. The sale of goods of this sort would be undoubtedly promoted if American experts could be on hand to demonstrate the American apparatus."

Personals

W. J. FULLER, American representative of Alfred Herbert, Ltd., sailed on Jan. 4 for England and the Continent.

MARCUS A. COOLIDGE, president of the Fitchburg Machine Works, Fitchburg, Mass., sailed on Jan. 1 for Paris to attend the peace conference.

WILLARD A. JOHNSON, who was formerly with the National Acme Co., Cleveland, Ohio, has joined the sales force of A. H. & F. H. Lippincott, Inc., Philadelphia, Penn.

T. T. FAUNTLEROY has been appointed sales engineer for the Lakewood Engineering Co., Cleveland, Ohio, with headquarters at 1034 Widener Building, Philadelphia. He was formerly New York branch manager for the Gurney Ball Bearing Co.

J. EDWARD GRINFIELD-COXWELL, who has been for a number of years Eastern sales manager of the Columbia Steel and Shafting Co., Pittsburgh, Penn., has started in business for himself with offices in the Marshall Building, 40 Central St., Boston, Mass. He will handle special accounts in cold-finished steels.

FREDERICK PEARSON, for the past 15 years associated with Marshall Field & Co. as advisory engineer in the development of its various manufacturing and merchandising enterprises in Chicago and elsewhere, has opened a consulting engineer's office in the Marshall Field Annex Building, Chicago. He will continue as advisory engineer to the above firm, in addition to other interests engaging his service. Mr. Pearson's experience has been diversified, embracing electrical, mechanical and chemical engineering.

Obituary

A. D. GALLMEYER, superintendent of the foundry department of the Valley City Machine Works, Grand Rapids, Mich., died on Saturday, Nov. 23, 1918.

COL. LEROY T. HILLMAN, commandant of Rock Island Arsenal, Rock Island, Ill., died of pneumonia at his quarters on the island Sunday, Dec. 29, 1918. Colonel Hillman was placed in command at the arsenal early in 1918, succeeding Col. George W. Burr.

Business Items

The plant of the Joseph Reid Gas Engine Co., Oil City, Penn., was destroyed by fire on Dec. 28, 1918. The damage is estimated at $300,000.

The Peninsular Machinery Co., dealer in machine tools, has moved from 100 Beaubien St., Detroit, Mich., to larger quarters at 279-281 East Jefferson Avenue.

The McCrosky Reamer Co., Meadville, Penn., on and after Jan. 1 will be known as the McCrosky Tool Corporation. An increase in its field of business made this action necessary.

The Hess Steel Corporation, Baltimore, Md., has established a branch office at 50 Church St., New York. Daniel V. Foster, who is now representing the Hess Steel Corporation in that district, will be in charge.

The Brown Hoisting Machinery Co., Cleveland, Ohio, announces the following changes in its organization: Harry Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice president, general manager and director; Robert G. Clapp, director; John F. Price, director; Ewen C. Pierce, general manager of sales.

Wheelock, Lovejoy & Co., Cambridge, Mass., have dissolved partnership and have been incorporated under the name of Wheelock, Lovejoy & Co., Inc., with H. F. Simpson as president, A. O. Fulton vice president, and F. B. Lovejoy treasurer. They have been appointed general sales agents in the New England states for the Ludlum Steel Co., of Watervliet, N. Y.

The Metal Ball Co., with works at Danbury, Conn., and office at Bridgeport, Conn., has been incorporated under the laws of Connecticut for $50,000 and will make high-grade steel balls for bearing purposes. The officers of the company are George E. Crawford, president; W. Le Roy Ketchem, vice-president and sales manager, and George Smith, secretary and treasurer.

Dick, Kerr & Co., Ltd., held their annual meeting in London on Nov. 14. Important plans for the future were outlined by the chairman, who said that the work of consolidating the organization of the company with those of Williams & Robbinson and the United Electric Co. has been completed. He further announced that it had been decided to establish companies in France and Japan to exploit rights in connection with apparatus for railways and tramways.

The Minneapolis Steel and Machinery Co. has moved its offices and warehouse to S114-116 Monroe St. This firm has taken over the machinery business of the various branches, consisting of farm tractors, hoists and derricks, and all future business with the firm in Oregon, Washington and Idaho will be handled from this office. The Spokane branch will continue to handle the structural-steel business as usual. P. E. Lattner is the contracting engineer.

The East Side Foundry and Machine Co., Belleville, Ill., has been organized and is now in operation in a plant on the Louisville and Nashville Railroad Co. line. The officers of the company are as follows: President, C. P. Tomlinson; vice president, Frank Smiley; secretary-treasurer, Arthur H. Bassler; manager, Eugene Rhodes.

The National Sales Engineering Corporation, Kresge Building, Detroit, Mich., has been appointed exclusive sales representative for the Kelly Reamer Co., the Buhr-Buiwitt Co., the McCrosky Reamer Co. and the Nelson-Blanck Co. The officers are E. E. Minard, president and general manager; C. H. Eckhard, vice president, and T. J. Fraser, treasurer and secretary.

Trade Catalogs

Visible Index Rack. Dumont Visible Index Co., Kansas City, Mo. Circulars, two. Pp. 4; 3¾ x 6 in. These contain descriptive matter and illustrations showing the installation and use of the Dumont visible index rack.

Sellew 16-In. Crank Shaper. Sellew Machine Tool Co., Pawtucket, R. I. Circular. Pp. 4; 8½ x 11 in. A full description of the Sellew shaper is given with halftone illustrations and a table of dimensions and specifications.

The Kerosene Tractor Repair Price List. Hart-Parr Co., Charles City, Iowa. Booklet. Pp. 45; 6 x 9 in. Here a complete price list with correct name and code word is given of all repair parts of the three-plow kerosene tractor.

Labor Saving Tools. Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill. Circular No. 28. Pp. 49 x 12 in. Illustrates and describes the Thor pneumatic and electric tools and gives a table of specifications.

Spacers for Milling Machine Arbors. Detroit Stamping Co., 951-957 West Fort St., Detroit, Mich. Circular. Pp. 2; 8½ x 11 in. One side of this circular gives illustrations of various-sized spacers. On the other is a general price list.

The Safety Jack. Norlund Novelty Co., Williamsport, Penn. Catalog. Pp. 8; 5¾ x 7 in. A short description of the construction and uses of this new product is given, together with illustrations showing how it is used under an automobile axle.

Adlight. K. F. M. Lindblad, 65 Sudbury St., Boston, Mass. Booklet. Pp. 4; 3½ x 6 in. A brief description of this shaded individual light is given, together with halftone illustrations showing its use on the lathe, at the press, at the bench and on the desk.

The Prestometer. Coats Machine Tool Co., Inc., 30 Church St., New York. Catalog. Pp. 19; 7½ x 10¼ in. A short description of the Prestometer is given, together with instructions and illustrations showing its use with various tools. The last two pages give a list of the users of the Prestometer.

Air and Light in Foundries and Forge Shops. David Lupton's Sons Co., Welkel and Westmoreland Sts., Philadelphia, Penn. Booklet. Pp. 48; 6 x 9 in. The greater part of the booklet is filled with photographs and descriptions of many interior and exterior views of foundries, machine shops and factories. Three samples of construction are shown by a line drawing insert.

Saw and Knife Fitting Machinery and Tools. Machinery Company of America, general office, Big Rapids, Mich. Catalog No. 30. Pp. 224; 6½ x 9½. Covering the output of three factories for which this company acts as distributor—the Covel Manufacturing Co., Benton Harbor, Mich.; Baldwin, Tuthill & Bolton, Grand Rapids, Mich., and the Hanchett Swage Works, Grand Rapids, Mich. It describes and illustrates various types of saw and knife

fitting machinery made by these factories. It will be forwarded to interested parties free on request.

Zelnicker's Bulletin. Walter A. Zelnicker Supply Co., 325 Locust St., St. Louis, Mo. Catalog. Pp. 84; 3½ x 8¾ in. This is a complete list of all kinds of steam and motor railway supplies and equipment, also pumps, tanks, woodworking and contractors' machinery sold by this company. In each case a description and specifications are fully given.

How to Save Handling Expense in Factory, Warehouse and Stockroom. Barrett-Cravens Co., 711 Transportation Building, Chicago, Ill. Catalog. Pp. 32. This book described in detail the modern development of the Barrett lift truck as a means of handling material in factories, warehouses and stockrooms. Three pages are filled with illustrations showing special racks and platforms.

Philadelphia Gears. Philadelphia Gear Works, 1120-1128 Vine St., Philadelphia, Penn. Catalog. Pp. 84; 5½ x 8½ in. This contains illustrations and specifications of generated spur, bevel and spiral gears, rawhide and micarta pinions, worms and worm gears, racks and lead screws, sprockets and diamond chains. It also contains a page of useful information and a general price list.

Elevating and Conveying Machinery and Labor Saving Equipment. Gifford-Wood Co., Hudson, N. Y. General catalog No. 18. Pp. 480; 6 x 9 in. This is a reference book for engineers, manufacturers and plant managers and shows the application of labor-saving ideas for various industries. All types of elevators and conveyors are fully illustrated; tables of dimensions and prices are given.

Karnetic Holding Device. The Kar-Engineering Co., Inc., 79 East 130th St., New York. Catalog. Pp. 12; 6 x 9 in. Several illustrations are given of the Karnetic parallel V block and protractor-holding device for grinding at angles and for working on irregularly shaped pieces. Other illustrations give a few examples of work performed with Karnetics. Every page contains descriptive information.

Instructions for the Operation and Care of Tractors. Hart-Parr Co., Charles City, Iowa. Booklet. Pp. 32; 6 x 9 in. This is a complete handbook giving the care of the tractor in cold weather; how to start and stop the motor, lubrication instructions, care of the carburetor and its adjustments, the valve and ignition systems and other hints concerning the care and use of both kerosene or gasoline tractors.

Small Tools. The Cleveland Punch and Shear Works Co., Cleveland, Ohio. Handbook No. 6, pp. 40; 4½ x 7¼ in. Illustrating and describing the Cleveland line of standard small tools, such as chisel blanks for pneumatic chippers, cold cutters, coupling nuts, cutting edges, dies, markers, punches, wrenches and numerous other small tools. The company also manufactures special tools, and the catalog contains specification sheets for use in ordering.

Ball Bearings. Hess-Bright Manufacturing Co., Philadelphia, Penn. Catalog. Pp. 108; 6¼ x 9¼ in.; cloth bound. This little brochure gives a history of the development of ball bearings, shows their use in the automobile, airplane, machine tools, flour and feed milling machinery, wood-working and electrical machinery, mining locomotives, street railways and in other miscellaneous ways. It is plentifully illustrated and contains several tables and a price list.

Tool Steels. Carnegie Steel Co., Pittsburgh, Penn. Catalog. Pp. 24; 5 x 7¾ in. A new line of carbon electric tool steels recently placed on the market by this company is described, together with instructions for hardening and tempering each of the five grades. The pamphlet is intended for the actual user of tool steels and contains practical information without an extended discussion of theories. A chart of heat colors with their corresponding Centigrade and Fahrenheit temperatures is included as well as a chart of temper color. Lists are also presented showing the proper carbon content for various lines of tools.

Gisholt Turret Lathes. Gisholt Machine Co., Madison, Wis. Catalog TLC-1. Pp. 102; 7½ x 9½ in. The first part of this book gives a number of halftone illustrations showing Gisholt lathes at work. Following this section are 18 pages carrying examples of parts that have been finished on Gisholt lathes. Then follow several pages of illustrations showing the installations of these machines in various shops and a general description of standard Gisholt turret lathes. The last part of the book is devoted to standard tools for lathes, toolholders and chucks, also the turret on carriage and gap lathes as well as the motor-driven lathes are illustrated and described.

New Publications

The Flying Book—The Aviation World's Who's Who and Industrial Directory.—Edited by W. L. Wade. Two hundred and eighty-two 5½ x 8¼-in. pages; profusely illustrated. For sale by Longmans, Green & Co., New York. Price, $1.75.

This book is crammed full of pertinent information about airplanes, airplane motors, manufacturers and men prominent in the airplane field. Details of the main dimensions and power of all the well-known machines are given. These details are so arranged as to be easily found. The illustrations in outline are a valuable feature. Records of various flying achievements are given, and altogether this is a good reference book for those interested in airplanes and motors of the different types.

Oxweldıng and Cutting—A Manual of Instruction.—By the Oxweld Acetylene Co. One hundred twenty-six 5 x 8-in. pages; 71 illustrations, 4 tables; paper covers. Issued to those interested through Murray Howe & Co., 30 East 42d St., New York.

To those interested in the practical application of oxyacetylene welding and cutting, this book will prove to be exceedingly informative. Beginning with a brief historical sketch of the development of autogenous welding and cutting, the reader is rapidly taken through the fundamentals of the process. After showing how to handle the blowpipe and other apparatus in a general way definite examples of almost every conceivable form are shown and minute instructions given. These examples apply to both welding and cutting. The clearness of the text and the pertinent illustrations make the subject easily understood by any student or practical operator.

Steel and Its Treatment—By the Metallurgical Staff of E. F. Houghton & Co., Philadelphia. Third edition; 165 5 x 7½-in. pages; 45 illustrations and numerous tables and specification lists. Bound in cloth boards.

This is a very comprehensive little book for the steel and iron worker. The first part covers the steel field in general, and the last is devoted to the S. A. E. specifications for steel, which places it in a form for ready reference that will be appreciated by the practical man. The chapter headings are: Composition of Steel, Thermal Critical Points of Steel, Classification of Steel, Effect of the Elements in Steel, Annealing, Physical Properties, Pyrometers, The Thermal or Heat Treatment of Steel, Carburizing, Casehardening, Carburizing Material, Heat Treatment After Carburizing, The Hardening of Steel, Drawing or Tempering, Furnaces for Casehardening, Heating, Fuels, Quenching and Miscellaneous Hardening Methods.

Standardized Leather Belting — Thirty-eight 5 x 7½ in. pages; illustrations and tables. Published by the Graton & Knight Manufacturing Co., Worcester, Mass. Free to those interested in belting.

This is a convenient little booklet for belt users in general, although primarily put out as an advertisement for G. & K. belting. The subjects treated are: History and Advantages of Standardization, pages 3 to 6; Standardized Series Leather Belting pages 8 to 22; Tables of Belting Standards for Various Industries, pages 23 to 30, and Rules and Tables, pages 31 to 38. The rules and tables are naturally of interest to all belt users, as they contain articles on such subjects as How to Order Belting, Mechanical Rules Regarding Belting, Horsepower of Belts, Rules for Finding the LeLngth of a Belt When It Is Inconvenient to Use Tape, and Conservative Estimate of Horsepower for Both Double and Single Belts.

Hendricks' Commercial Register of the United States for Buyers and Sellers.—Two thousand three hundred and eighty-four 7¾ x 9¾-in. pages. Twenty-seventh annual edition, 1918-1919. Published by the S. E. Hendricks Co., Inc., 2 West 13th St., New York. Price, $10.

The new edition of this valuable reference book for buyers or sellers has been thoroughly revised and brought up to date. For those not familiar with this book, reference is made to a complete alphabetical list of trade names of over 200 pages two columns each. This list is printed on pink paper to easily identify it, and is placed in the body of the book between the main classified pages and the alphabetical list of firms containing close to 1000 columns of names and addresses. The group arrangement used in the classified-trade section saves much valuable time for those seeking reliable information. To the modern business office this book is almost as indispensable as a typewriter.

Brass Founding.—By Joseph G. Horner. One hundred and eighty-two 5½ x 8¼-in. pages; 247 illustrations; bound in green cloth boards. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 5s. ($2).

Beginning with a short historical sketch of the origin and nature of brass the author writes generally of the different mixtures used. The descriptions are those of a compiler and not of the practical metallurgist or founder. The few definitely proportioned mixtures given are hidden in the text, and not put in the form of tables which could be easily referred to. The descriptions of furnaces are well illustrated by sectional views, and the names of various makers of the apparatus is a feature that will be appreciated by practical men. The examples are nearly all taken from English practice, which differs considerably from American, especially in cases where large quantities are to be melted. The subject matter dealing with appliances, patterns and molds is of an elementary character. The various chapter headings are Introduction; Origin of Brass; Furnaces, Crucibles, Sands; Appliances; Joints; Joint Boards, Odd Sides and Plates; Patterns, and Examples of Molds.

The Safety Movement in the Iron and Steel Industry, 1907 to 1917.—By Lucian W. Chaney and Hugh S. Hanna. Three hundred 5¾ x 9-in. pages; 35 illustrations, 36 charts and 116 tables; paper covers. Published by the United States Department of Labor, Bureau of Labor Statistics, Washington, D. C.

This is a valuable book to those interested in safety statistics and safety appliances. It is divided into two parts, the first consisting of a review of the safety movement, with special reference to the war, and the second dealing with the causes and prevention of accidents. The chapter headings of the Part II are Industrial Accident Rates, Physical Causes of Accidents, Causes of Accidents in Blast Furnaces, Causes of Accidents in Steel Works and Foundries, Causes of Accidents in the Mechanical, Fabricating and Yard Departments, The Human Factor in Accident Occurrence, What Are the Limits of Accident Prevention? Nature of Injury, Progress of the Safety Movement in the Iron and Steel Industry, Accident Experience by Department and Occupations, The Methods of the Safety Man. The tables and charts put the material in a form for ready reference.

Forthcoming Meetings

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$37.60	$37.60
Northern Basic	34.80	34.80
Southern Ohio No. 2	35.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	39.55	39.15
Virginia No. 2	41.70	41.70
Southern No. 2	41.70	41.70
BIRMINGHAM		
No. 2 Foundry	34.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	39.15*	38.85*
Virginia No. 2	40.50†	40.50†
Basic	36.90*	36.60*
Grey Forge	36.90*	36.60*
Bessemer	39.10*	38.80*
CHICAGO		
No. 2 Foundry Local	34.50	34.50
No. 2 Foundry Southern	39.00	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	35.40	35.40
Basic	34.40	34.40
Bessemer	36.60	36.60

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York		Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.07	$4.27	$4.20	$3.97	$4–4.04	$4.07	$4.20
Soft steel bars	3.97	4.17	4.10	4.07	4–4.04	3.97	4.10
Soft steel bar shapes	3.97	4.17	4.10	4.07	4.14	3.97	4.10
Soft steel bands	4.57	4.77					
Plates, ¼ to 1 in. thick	4.27	4.52	4.45	4.42	4.39	4.27	4.20

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.50
Warehouse, New York	4.75	4.70
Warehouse, Cleveland	3.90	4.98½
Warehouse, Chicago	4.10	4.10

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	4.70	6.22	6.52	6.445	6.00	6.45	6.22	6.445
*No. 26 black	4.60	6.12	6.42	6.405	5.90	6.35	6.12	6.405
*Nos. 22 and 24 black	4.55	6.07	6.37	6.295	5.85	6.30	6.07	6.295
Nos. 18 and 20 black	4.50	6.02	6.32	6.245	5.80	6.25	6.02	6.245
No. 16 blue annealed	4.10	5.37	5.72	5.645	5.20	5.65	5.37	5.645
No. 14 blue annealed	4.00	5.27	5.62	5.545	5.12	5.55	5.27	5.545
No. 10 blue annealed	3.90	5.17	5.52	5.445	5.05	5.45	5.17	5.445
*No. 28 galvanized	6.05	7.57	7.77	7.695	7.25	7.70	7.57	7.695
*No. 26 galvanized	5.75	7.27	7.47	7.395	6.95	7.40	7.27	7.395
No. 24 galvanized	5.60	7.12	7.32	7.245	6.80	7.25	7.12	7.245

* For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 9%	List plus 25%
Cleveland	List plus 7%	List plus 10%
Chicago	List plus 9%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$25.50–30	$15.00
Cleveland	20.00	15.30
Chicago	16.50	15.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
5/16, 1/4, 3/16, 5/32, 1/8, No. 8, 7/64 and No. 10	25.50 to 33.00	1/4 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
5/64, No. 14 and 1/16		5/16 by 19 in. long	10.00
No. 18		3/8 by 21 in. long	10.00
No. 20		* Special Welding Wire	
* Very scarce.		1/4	33.00
		5/16	30.00
		3/8	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.77	4.75	4.77
Cold-rolled strip steel	8.02	8.25	8.57
Floor plates	6.27	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
1/8, 1/4, and 3/8	47%	20½%	1/8 to 1¼	36%	20%
1/2	51%	36½%			
3/4 to 3	54%	40½%			

LAP WELD

2	47%	34½%	2	29%	15%
2½ to 6	50%	37½%	2½ to 6	31%	18%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	43%	25½%	1/8 to 1¼	36%	21%
1/2	48%	35½%			
3/4 to 1¼	52%	39½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45%	33½%	2	30%	17%
2½ to 4	48%	36½%	2½ to 4	32%	20%
4½ to 6	47%	35½%	4½ to 6	31%	19%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¼ to 3 in. steel butt welded	40%	28%	43%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	36%	25%	39%	23%	37.1%	23.1%

Malleable fittings, Class B and C, from New York stock sell at list + 15%. Cast iron, standard sizes, 5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	21.00*	26.00	23.50
Tin in 5-ton lots	72.00	72.00	85.00
Lead	5.75	7.05	6.50
Spelter	7.85	8.60	8.00
ST. LOUIS			
Lead	5.45	6.75	6.35
Spelter	7.50	8.25	7.55

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	35.00	38.00	31.00	35.00	32.50	36.00	35.00
Copper wire (carload lots)	32.00	35.00	32.00	32.00	28.50	33.00	34.00
Brass sheets	36.75	39.75	30.75	35.00	33.00	33.50	35.00
Brass pipe	40.00	46.00	36.50	38.00	40.00	44.00	41.00
Solder (half and half) (case lots)	55.00	55.00	48.00	47.00	43.25	56.00	41.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$36.00	$25.00
New York	38–40	30.00
Cleveland	34.00	34.00
Chicago	29.50	37.00